



A11106 323472

NBS
PUBLICATIONS

NBSIR 80-2038

Psychological Deterrents to Nuclear Theft: An Updated Literature Review and Bibliography

George W. Lapinsky, Jr.
Clare Goodman

Center for Consumer Product Technology
National Engineering Laboratory
National Bureau of Standards
Washington, D.C. 20234

Prepared by
Law Enforcement Standards Laboratory
U.S. Department of Commerce
National Bureau of Standards
Washington, D.C. 20234

May 1980

Issued June 1980

Prepared for
Surety and Operations Directorate
Defense Nuclear Agency
Washington, D.C. 20305

This work was sponsored by the Defense Nuclear Agency under:
Task Code B99QAXRA101 and Work Unit Code 08

QC

100

.U56

80-2038

1980

c. 2

630

JUL 11 1980

Not acc - Circ
QC100
.U56
NO. 80-2038
1980
C.2



Jordan J. Baruch, Assistant Secretary for Productivity, Technology, and Innovation

Acknowledgments

The authors of this report wish to thank Sharon Lyles for an outstanding job of typing the original manuscript and revisions. Special thanks also to Arnold Perrey for his translation and interpretation of a foreign language journal article, and to Robert Kershner and Joel Kramer for their constructive criticism and suggestions throughout various phases of the project.

Contents

	Page
Introduction	1
Background	1
Objective and Scope	1
Methodology	1
Format	2
Intruder Characteristics	2
The Criminal Population	3
The Terrorist Population	4
The Psychopathological Population	5
The Insider Population	6
Psychological Deterrents	7
Pre-event Deterrents	8
Information Management and Public Relations	8
Intelligence Gathering	8
Training and Selection of Personnel	8
Event Phase Deterrents	9
Sensory Assaults	9
Noise and Vibration	9
Electromagnetic Radiation	10
Temperature	10
Strenuous Physical Exertion	11
Pain	11
Smell	12
Cognitive and Perceptual Deterrents	12
Perceptual Processes	12
Information Overload	13
Personal Threat	13
Post-Event Deterrents	13
Contingency Planning and Crisis Management	13
Summary	14
Implications for Future Research	14
Bibliography	14
Intruder Characteristics	14
Information Management and Public Relations	22
Intelligence Gathering	25
Training and Selection of Personnel	26
Noise and Vibration	28
Electromagnetic Radiation	30
Temperature	31
Strenuous Physical Exertion	32
Pain	33
Smell	34
Perceptual Processes	35
Information Overload	36
Personal Threat	38
Contingency Planning and Crisis Management	41

Psychological Deterrents to Nuclear Theft:
An Updated Literature Review and Bibliography

George W. Lapinsky, Jr.
Clare Goodman

A review of the unclassified literature dealing with psychological deterrents was conducted for the Defense Nuclear Agency (DNA). The review indicates that while human psychological processes (sensory, perceptual, and cognitive) can be manipulated by various means, definitive empirical data are lacking which directly relate to deterring nuclear weapon theft. Behavioral impact research should be undertaken by DNA to ascertain the deterrence values of the many techniques identified.

Key words: Cognitive processes, nuclear weapon theft; perceptual processes; psychological deterrence; security systems; sensory processes.

INTRODUCTION

BACKGROUND

Behavioral sciences play a new role in the field of physical security of nuclear storage and processing facilities. The Defense Nuclear Agency (DNA) program to enhance the security of nuclear weapon storage facilities includes behavioral analysis of psychological processes as well as the traditional consideration of physical barriers and alarms. By including a multitude of physical and psychological deterrents, security systems designers can create an environment that enhances the probability of preventing potential intruders from making a successful penetration into nuclear weapon storage facilities.

OBJECTIVE AND SCOPE

This report, prepared for the Defense Nuclear Agency (DNA), provides an annotated bibliography and an analysis of the literature on the topic of psychological deterrents to theft from nuclear weapon storage facilities. The purpose of this study was to update and expand upon the preliminary unclassified literature review published by P. G. Meguire and J. J. Kramer (NBSIR 76-1007) covering the literature up to 1975. This report reviews the literature from 1975 to the present and expands into several new topic areas not covered in the first report, but which could be applied to existing and new security systems to increase the level of security.

METHODOLOGY

Since security is an interdisciplinary field, its literature is widely dispersed. Therefore it was necessary to review several data bases and other informative sources. These include: the National Criminal Justice Reference Service (NCJRS) maintained by the Department of Justice, National Institute of Justice; Psychinfosearch, the data base of the American Psychological Association; National Technical Information Service (NTIS); Defense Documentation Center (DDC); Sociological Abstracts; Ergonomics Abstracts and Social Science Citation Index.

As references, reports, and articles were obtained from these sources, all reference lists within the reports were checked for additional relevant articles. The card catalog and abstracts from the library of the Defense Nuclear Agency were manually searched.

As reports became available, they were scanned and categorized according to criteria of relevance and methodological soundness. A six point scale was used for both criteria. An article was subsequently reviewed in depth if it was in the top three categories of relevance and methodological soundness. During this review and annotation process, more deletions were made when closer reading revealed some reports still to be at variance with the criteria. The relevance criterion was based on an article's applicability to the psychology of deterrence or to physical security. The methodological soundness criterion was based on an assumed continuum of scientific rigor ranging from controlled experimentation to speculation. Because of the nature of the field of physical security, much of the literature is speculative. An attempt was made to discriminate between sound expert opinion and unqualified speculation on the basis of personal judgment in order to retain as much of the relevant security literature as possible.

FORMAT

Each subject area includes a discussion and summary of the literature. In cases where the literature search revealed no new information, the discussion will obviously be brief and the reader is directed to the Meguire and Kramer review (NBSIR 76-1007) for a fuller account. The bibliography section contains both fully annotated entries and simple reference citations because some references dealt with the subject area only tangentially or not in depth. Full annotation of such minor references would be inappropriate for this report.

INTRUDER CHARACTERISTICS

The literature relevant to the description of possible adversaries to nuclear security generally applied one of two main methodologies: 1) the empirical, data-gathering approach, such as Edward Mickolus' project ITERATE [25]*and the Rand Corporation's data base of analogous incidents [11] ; and 2) the case study or expert opinion approach in which each incident is analyzed in depth as a unique event, which may or may not have commonalities with other incidents - the work of Gustave Morf [28] concerning the FLQ (Front de la Liberation Quebecois) in Quebec, that of Jay Mallin [22] on unconventional warfare, and David Hubbard's study of skyjackers [16] are all good examples of this approach. The limitation of both of these approaches in this discussion is that they are concerned with analogous incidents - there is no unclassified data base of nuclear theft incidents. In the past this shortcoming has led security specialists in the nuclear field to design their deterrents for the "worst-case" situation. It has not been possible, thus far, to construct a detailed psychological profile of an adversary to nuclear security. As the data bases of analogous events become more refined, construction of such a profile may become feasible (for pros and cons of profiling see Pickrel [32], DeNicke [9], Hubbard [16], and Rappoport and Pettinelli [33]).

*Numbers in brackets refer to references in the bibliography to this report.

For the present, the "worst-case" situation shall be assumed, that is, that the population of possible intruders cannot be specified and may include anyone who is operationally effective in any of a multitude of possible scenarios. This assumption is partially confirmed by the historical and demographic data now available concerning criminal and terroristic acts. (See following sections.)

For the sake of simplicity, one may categorize possible intruders into one or more of the following groups: 1) criminal, 2) terrorist, 3) psychopath, and 4) insider. The insider is included as a special category because of the unique opportunities of access, and because certain characteristics of his or her personal background have, hopefully, been predetermined by various selection factors and processes. The open literature provides some general information about the characteristics of each of these four groups, but it is by no means definitive. The following sections will provide information on each of these four potential adversary groups with regard to the following characteristics: age, sex, intelligence, personality, and motivation.

THE CRIMINAL POPULATION

Age: The FBI Uniform Crime Reports for 1977 [10] reported that the highest percentage of arrests in the United States for all types of crime was in the age bracket of 25-34. However, the distribution is a rather flat one, that is, involvement in crime, as measured by arrests, begins at ages 13-14 and continues at a fairly stable rate until the age of 50 with significant peaks at the 25-29 and 30-34 age ranges. Children 10-and-under accounted for 1.7% of all arrests for serious crimes in 1977 and people 65-and-over accounted for .7%.

Sex: In the U.S. there has been a phenomenal increase in arrests of females for serious crimes. Haskell and Yablonsky compared crime statistics for the years 1960 and 1967 and found an increase of female involvement in serious crime of over 100% [15]. This trend was accelerated slightly in the years 1968-1977 to a 115.5% increase. Women are now involved in approximately 15-20% of all crimes in the U.S. [10]. The predominance of males in crime according to Cressey (in Sykes & Drabek [39]), is experienced "in all nations, all communities within a nation, all age groups, all periods of history for which organized statistics are available, and for all types of crime except those peculiar to women, such as infanticide and abortion." The degree of overrepresentation of males in crime varies with culture, size of community, age groups, and certain social variables - males hold a less commanding lead in arrest rates in large cities of free, Western hemisphere countries, especially among 15-17 yr olds.

Intelligence: The literature shows no reason to assume that the intellectual functioning of the criminal population is not distributed normally. In the Rand Corporation's analysis of crimes analogous to nuclear theft, the "typical" adversary group was highly skilled in planning and mid to high in ingenuity and imagination [11].

Personality and Motivation: Schuessler and Cressey (in Haskell & Yablonsky [15]) analyzed the results of 113 studies comparing the personality test scores of criminals and control groups and concluded that "... the evidence favors the view that personality traits are distributed in the criminal population in about the same ways as in the general population."

Concerning motivation, Sutherland (in Sykes & Drabek [39]) states that "While criminal behavior is an expression of general needs and values, it is not explained by those general needs and values since non-criminal behavior is an expression of the same needs and values." Knowledge of motivating

factors may allow some speculation concerning the level of dedication or the amount of risk an intruder might be willing to take, but at this point we can only speculate as to probable criminal motivations to a nuclear theft. In the literature several possible motives are mentioned: the first, and most obvious, being money, the less mentioned being power, status, intellectual challenge, obedience to orders, and the release of comrades from prison.

THE TERRORIST POPULATION

Age: The literature on terrorism seems to show that, historically, terrorist guerrillas generally are between 22 and 25 yr of age. Terrorist leaders are usually older, mid-30s to early 50s. Russell and Miller [34] report that children 12-14 yr of age have been involved in acts of terrorism in Northern Ireland.

Sex: According to the Russell and Miller article, "Profile of a Terrorist" [34], terrorism is still predominantly a male phenomenon. Women were involved in significant terrorist operations less than 20% of the time in the years 1966-1976. They also reported that the male/female division of labor was generally based on optimizing the efficiency of the terrorist operation - for example, women are often used to establish "safe houses," gather intelligence, and so forth because females arouse less suspicion than males in these kinds of activities (see also, Disorders & Terrorism [29]). However, women can and do take on leadership and execution roles as well as support roles, as exemplified by Ulrike Meinhof, Patricia Hearst, and others.

Intelligence: According to several authors [13,28] terrorists seem, generally, to be average or above average in intelligence. "In fact," say Russell & Miller [34] "approximately two-thirds of those identified (as) terrorists are persons with some university training, university graduates or postgraduate students."

Personality and Motivation: There are some direct observations and personal interviews encountered in the open literature concerning the psychological aspects of terrorism, but for the most part, the personality of the terrorist remains in the realm of secondhand observation and speculation.

In the global sense, the only definable difference between the general population and the population of probable intruders, including terrorists, is the means by which the latter seek to obtain their goals, that is, by illegitimate and usually violent means. Three factors involved in this choice to abandon the legitimate course of action are: 1) intruder goals are perceived to be incompatible with those of the legitimate authority; 2) legal avenues of negotiation are perceived to be closed, inaccessible, or logically inappropriate; and, 3) the illegitimate act is perceived to be a viable alternative. Associated with each of these factors are personality characteristics or learned modes of action which have been attributed to terrorists by various authors: 1) The first factor, incompatible goals, is associated with characteristics such as alienation, hopelessness, personal inadequacy, "existential" fear or fears of the Armageddon, feelings of relative deprivation, social isolation, ethnocentrism, and distortion of reality. 2) Perceived lack of legal avenues of negotiation is associated with feelings of frustration, feelings of urgency to act, and feelings of superiority over the common masses and the ability to discern the common good, in addition to many of the same attributes associated with the first factor. 3) Perception of an illegitimate, and often violent act as a viable alternative, has as its correlates such characteristics as feelings of urgency, extreme fear, dehumanization or depersonalization of victims, diffusion of responsibility within groups, obedience to an authority figure,

rationalization, distorted attribution of aggressive arousal, inadequate reaction to threats of punishment, and the feeling that terrorism and violence are, if not acceptable, at least effective.

There are some cases which blend terrorism and psychopathology, such as the Japanese Red Army [23], or the infamous "Manson family." However, most authors agree that the credible terrorist groups are not cadres of madmen, but are rational human beings subject to the same laws of behavior as the general population. (See Anthony Arblaster's "Terrorism: myths, meaning and morals" for an excellent review of the terrorism literature [2].)

Concerning motivation, the literature on terrorism seems to lead to the conclusion that although most terrorists are politically motivated, criminal motivations such as the accumulation of money or weapons, and the release of comrades from prison may be the specific motivational trigger. Their dedication is said to be high, in many cases including willingness to risk serious injury and death. Statistics on the most prevalent mode of terror suggest that terrorists do try, however, to minimize their risks. According to Mickolus (in Alexander & Finger [25]) bombings accounted for 55% of international terrorist incidents in the years, 1968 through 1975. Personal violent confrontations in the form of assassination or armed attack accounted for only 9%.

THE PSYCHOPATHOLOGICAL POPULATION

Three types of mental disorder were felt to be worthy of consideration for the purposes of this report: the explosive personality, the antisocial personality, and the variations of the paranoid personalities.

Age: It is generally accepted that the forms of personality disorder of interest to this discussion (mentioned above) can develop at any age, but are more likely to assume socially dangerous dimensions only in the teenage years or later [1,31].

Sex: Since manifestations of mental illness vary from culture to culture and from family to family as a function of socialization and genetic processes, it would be presumptuous to assert that either sex manifests more explosive behavior, more paranoia, or more antisocial behavior simply by reason of sex. The available statistics seem to confirm this. Concerning the paranoid forms of psychopathology, Page [31] states that the prevalence rates are about the same for males and females.

Intelligence: Because of the interactive effects of intelligence, socioeconomic status, likelihood of diagnosis, treatment, and institutionalization, it is virtually impossible to ascertain the degree of correlation, if any, between intelligence and various forms of mental illness. Regarding hospitalized patients, Page [31] asserts that "paranoid patients tend to be brighter and better educated than most persons hospitalized with other diagnoses..."

Personality and Motivation: The explosive personality is characterized by normal adjustment interspersed with short periods of explosive rage, which are sometimes followed by a loss of memory of the aggressive incidents. The aggressive behavior of the explosive personality is usually undirected, impulsive, and often so overwhelming that all cognitive control is lost. For these reasons, the probability of this type of personality attempting a coherent and credible intrusion and theft is low. Even with inside access, there is a high probability that such a person would be recognized as a security risk before any significant damage could be done.

Antisocial personalities are characterized by their impulsiveness, low frustration tolerance, and lack of anxiety, guilt, or remorse for violating

social, legal, or moral codes. Punishment seems to have no deterrent effect on subsequent behavior. Because antisocial personalities are grossly selfish, irresponsible, and unable to learn from experience or punishment, it is likely that there will be a criminal history in this individual's personal background, though not necessarily so. Excessive use of alcohol and drugs, poor job history, sexual deviance, and a high incidence of divorce and marital conflict are also typical of this group.

Three types of paranoia are described in the literature: the paranoid personality, paranoid state psychosis, and paranoid schizophrenia. The paranoid personality is characterized as jealous, suspicious, rigid, hypersensitive, and having a primitively developed delusional system in which the individual basically distrusts others and isolates herself or himself from them [1,31].

Paranoid state psychosis is characterized by the same qualities as the paranoid personality except that the delusional system is more developed and complex, and consists of delusions which are rather bizarre, grandiose, and of a persecutory nature. Because the delusions of paranoid state individuals seem far-fetched, these individuals tend to be secretive about their true views of reality and easily take on the facade of normality [1,31].

The paranoid schizophrenic is characterized by an even greater break with reality, the delusional system being fantastic, inconsistent, illogical, and often accompanied by vivid hallucinations (usually auditory). These individuals are less able to encapsulate their delusions through secrecy and are more obviously eccentric in their behavior [1,31]. According to Page [31], these types of paranoid pathologies account for less than 1% of all first admissions to public and mental hospitals.

Motivations of this group may range from genocide to suicide, and most probably will be conceived of as self-defensive because of the persecutory nature of this group's set of delusions. Their dedication is theoretically limitless because their distortion of reality may affect important cognitive abilities such as risk perception.

THE INSIDER POPULATION

Age: Since this population may include civilian support staff, the age range is extended beyond the military limits somewhat and is estimated to be 16-70 yr of age. Within the exclusion areas, where only military personnel are allowed, the ages are estimated to range from 18-50 yr [3].

Sex: The percentage of females in the total nuclear security guard force is estimated at 10% or less by DNA [3]. It should be noted that, as with the terrorist population, females in nuclear security are not randomly distributed among jobs, but are utilized more in certain jobs than others because they have been found to be more operationally effective in those jobs. A comparison of sex differences in job satisfaction or morale in the services could not be found in the open literature.

Intelligence: The intelligence level of the insider population can be, or has been, determined specifically. It may be assumed that they are functionally average or above average concerning nuclear security matters due to their training and social contact with others in the security field.

Personality and Motivation: Because of self-screening biases, in the form of career choice and field of specialization, and because of formally imposed screening processes such as the Department of the Army's Personnel Reliability Program (PRP), there may be personality differences between the general population and those persons involved in nuclear weapons operations.

This literature search, however, revealed no data to confirm or deny the existence of such differences.

Concerning motivation, one may speculate that, in addition to motives generally applicable such as greed, one may also add to the list: revenge, rebellion against authority, symbolic protest, and suicide. Two of the more plausible insider scenarios involve the criminal insider and the mentally disturbed insider.

A 1968 study by H. E. Guttman [14] is one of the few sources in the open literature which gives any indication of the extent of the insider problem. His estimate of the probability of an incidence of a psychotic (paranoid type) with malevolent intentions being employed at or seeking to gain employment at a specific nuclear weapons lab was 2.5×10^{-7} or less. In real numbers this translated to an incidence of 1 per 5000 persons per year at a facility such as the Sandia Corporation during 1968.

Although Guttman's data and assumptions seem reasonable, his reassuring estimate could rise in value dramatically if any of the underlying assumptions were to be violated in the real life situation, or if any of the component probabilities were inaccurately estimated. It should also be emphasized that this probability is only for the incidence of an in-house psychotic with malevolent intentions. The probability that a rational insider with criminal intentions will attempt a nuclear theft may be as high or higher.

In addition, one must keep in mind that since the population in question is fairly large and will probably grow even larger in the future, a seemingly small probability may be critical. Also, the pool from which an insider may be recruited is increased tremendously if one includes ex-military people. Mickolus [26] estimates that there are several hundred thousand of these people who have specific training in nuclear weapons procedures. If these estimates are correct, the world-wide population of persons with sensitive inside information is probably near 500,000.

In summary, males age 18-50, appear to be the most probable adversaries to a nuclear weapons security system. A violent confrontation, such as a terrorist attack, would most likely involve men in their early-to-mid-twenties. Females are likely to be used in intelligence gathering, surveillance, and other covert activities. If females are used in an overt attack, it is likely that they would be young, highly dedicated, and as well-trained as their male counterparts. Individuals suffering from the mental disorders discussed above may present less threat to nuclear weapons security than individuals whose behavior is "normal." This is primarily because they tend to be more easily detected as security risks before they have an opportunity for intrusion or illegal access.

PSYCHOLOGICAL DETERRENTS

In view of the expanding areas of interest at DNA a broader definition of psychological deterrents is assumed than the one utilized in the Meguire and Kramer preliminary literature review (NBSIR 76-1007). Their review was limited to those deterrents that provided impact on site and that were primarily oriented toward the human senses. For the purposes of this study, a psychological deterrent shall be anything perceived by a potential perpetrator of a nuclear theft as lowering the probability of successfully attaining his or her goal (goal, here, may refer to something other than the theft of a nuclear weapon, such as publicity, embarrassment of governmental authorities, fulfillment of suicidal fantasy, and a multitude of other rational and irrational goals). The key word in this definition is "perceived" -- unless a deterrent is communicated to a potential intruder as

a relevant and credible threat to his or her success, it remains outside the realm of psychological deterrence.

If one conceptualizes deterrence as functioning over time, the theft scenario can be broken down into three major divisions: pre-event, event, and post-event. At each of these points in time there will be some major differences in environment, emotional state, physiological state, and the psychological set of the perpetrators, the counter-force, and the society-at-large. In this section a discussion of psychological deterrents appropriate to each of these divisions of the theft scenario will be presented.

PRE-EVENT DETERRENTS

Information Management and Public Relations

The dissemination and denial of information are an important part of the deterrence model. Several authors suggested that correct information management procedures could be used to optimize the effectiveness of a deterrence system. Almost all, however, were opposed to the use of "news black out."

Certain pieces of information must be communicated to the public regarding attempted nuclear theft. The first is the certainty of detection and punishment (rather than the severity of punishment). The second, but equally important, is the availability of non-violent alternatives - as Hans Toch puts it, "...ultimately, violence occurs because men find it satisfying and effective in achieving their ends. Violence can thus only be fought by removing the incentives for it, and by changing the motives that produce it" [40].

Most authors feel that information dissemination should be approached cautiously and ethically in order to avoid the danger of its being perceived as propaganda. The social costs and benefits seem to militate against any comprehensive, mass media program of public relations. However, specific instances of communication with the public can be used to the advantage of all involved. If an attitude of honesty and goodwill is mutually developed, the community at-large may become a source of valuable intelligence [52] and a military image of benign strength may be perpetuated.

Intelligence Gathering

Several authors listed improved intelligence as a top priority for deterring crime, especially terrorism. At least one was opposed to increased intelligence on the grounds of cost and legal and social appropriateness (see Moynihan in Elliot and Gibson [55]). This search of the literature turned up no empirical proof that intelligence gathering deters. Based on anecdotal information, it is assumed that there is a deterrent effect, if only because good intelligence increases the probability of detection.

Training and Selection of Personnel

A well-trained nuclear security guard force is mentioned by several authors as an important safeguard as well as a visible deterrent. Proper selection and training techniques can be used to enhance the competence of the guard force, to increase morale, to lessen the probability of collusion, and to project an image that is reassuring to the general public and threatening to potential adversaries.

The comments of several authors about the relative vulnerability of security systems to compromise by female adversaries suggest that female guards could be used to greater advantage in many situations (Disorders and Terrorism, p.59 [63]; Russell and Miller p.25 [34]; Middendorf [27]). In addition, greater use of females in the guard force would help to reduce the masculine connotations associated with the military. Hubbard [16] , among others, hypothesizes that agencies with a masculine image may attract sexually inadequate individuals intent on proving their manhood or asserting their identity. He feels that these individuals are overrepresented in aberrant acts such as skyjacking. Further research is necessary in order to determine the most operationally effective use of both sexes in the guard force.

Specialized training in personal protection, recognizing surveillance, recognizing intelligence gathering behavior, tactical training, and anti-terrorist training could be used to enhance competence and to increase motivation in the guard force.

EVENT PHASE DETERRENTS

Sensory Assaults

As with other subject areas covered in this bibliography, the literature search revealed no direct applications of the psychological literature to the deterrence of nuclear theft. The effectiveness of the various potential deterrents can only be hypothesized at present.

Noise and Vibration

Despite hundreds of studies that have been conducted, the influence of noise on human responses is still unclear. Meguire and Kramer listed five means by which noise might be an effective deterrent. Basically these still remain the same.

1. Noise may act as an alarm for the security guards,
2. Noise may be used to warn intruders that their presence has been detected,
3. Noise may produce interference or masking of verbal communications between members of an assault team,
4. Noise may induce incapacitating physiological effects such as pain, dizziness, blurred vision, nausea, etc., and
5. Noise may have negative effects upon intruder intellectual and motor performance, hence slowing the completion of the attack.

After reviewing several studies it became evident that human behavior is, on the whole, rather resistant to short-term noise. Moderately intense noise, although distressing, does not usually impair performance unless the task is an extremely difficult one. Under some circumstances, though, adverse effects do occur such as when noise masks auditory information, or a temporary hearing loss reduces an individual's ability to receive messages.

Vibration, on the other hand, can induce a whole variety of effects, depending on the frequency, intensity, and displacement characteristics of the vibration. According to Guignard [72] changes in heart action, respiration, and circulating stress hormones have been observed in response to whole-body vibration. Hasan [75] also states that an "inhibition" of tendon reflexes and the regulation of posture is disturbed.

For most tasks, the intruder will need to take in visual information. The biomechanical influence of vibration can reduce efficiency by interfering with visual input, such as by effecting the ability to make precise control adjustments. This was confirmed in a study by Drazin [68] which showed that, at around 3 to 4 Hz, impairment of vision was

particularly evident. Performance impairment was also quite evident at the 2 to 4 Hz level, but it should be noted that at higher frequency levels impairment was not as large. Cohen [66] also observed performance impairment occurred when subjects were exposed to a mixture of two different vibration intensities.

Within the reports reviewed on vibration, several tolerance limits were mentioned. Three interesting examples were:

1. At around 10-14 Hz the ability of the spine to cope with sudden accelerations was affected,
2. At around the 20 Hz the head begins to resonate with respect to the body,
3. Slow wave vibration of approximately .15 Hz to .30 Hz causes motion sickness symptoms in some subjects.

In addition to the physical effects mentioned above, there is some evidence that perceptual distortion of body position takes place when vertical oscillations of .1 to .5 Hz are used -- almost 50% of the subjects in one experiment perceived their position to be 90° out of phase with their true position (Malcolm, in Reason and Brand [78]). This phenomenon could be especially effective in an environment devoid of visual cues.

Finally, two studies completed by Grether et al. [71] are of particular interest. When heat, noise, and vibration were introduced singly and in various combinations, the results suggested that the combined stress condition produced less of an effect on performance than the individual stressors. The greatest impairment of performance resulted from the vibration stimulus alone.

Electromagnetic Radiation

The update provided little new information concerning the use of corpuscular and electromagnetic radiations. The most relevant findings were those concerning microwave radiation. Grinbarg and Sheyvekhman, in a review done by NASA [92], are cited as having reported a raising of the sensory threshold for pain and unspecified changes in auditory threshold as effects of short-term exposure (5 min) to radiofrequency energy fields. The proposed mechanism of this and other perceptual and behavioral effects is the heating and/or ionizing of neural cells. A subjective awareness of warmth was also reported. Once the peripheral nerves are heated above some unspecified minimum level, they may begin to fire spontaneously and cause perceptual and behavioral aberrations to occur. It is not known whether these effects can be generated quickly and reliably, without risking permanent damage to the nervous system.

The effects of visible light were well-documented in the Meguire and Kramer report on psychological deterrents and this update confirmed their findings. One minor addition is a report which suggests that, in addition to "flash blindness," intense flashes of light may under some conditions be used to distort color perception [8°].

Concerning the use of color, the literature remains at the speculative stage. One report suggests a possible line of further research, "the apparent heaviness of colours" [93]. If there is such an effect, it could be incorporated to make objects appear heavier or lighter than they really are.

Temperature

Meguire and Kramer discussed several effective ways temperature may be used as a deterrent. Little additional information on performance degradation and physiological tolerance is available from the literature except for the following minor addition. Several experiments on the effect of cooling the hands, reported that performance on several tasks involving

manual dexterity, including emergency egress, decreased with lowered finger surface temperatures [95,109]. Although bibliography of relevant literature is included, annotations and abstracts were deemed unnecessary for most citations since they added no new information.

Strenuous Physical Exertion

In addition to the effects of exercise mentioned by Meguire and Kramer in the preliminary review, there are a few other specific effects worth noting. Probably the most relevant to the subject of nuclear security is a study done by Wayne Evans [122] for the U.S. Army in which he examined the effects of fatigue on pistol firing. Evans concluded that heavy exercise did not affect accuracy but did affect time-to-fire. Evans explained, "The pistol firing task seems inherently to require accuracy. Thus, any disability suffered by the subject due to heavy work was not allowed to affect his accuracy but was reflected in an increased aiming time. A somewhat similar finding has been reported for rifle firing with gloves or gas masks used as impediments to performance (Gruber, et al. [123]). This also suggests pistol firing and rifle firing are affected similarly by stress."

That fatigue slows down physical movement patterns seems simple and commonsense, however, research such as that done by Bates, Osternig, and James [118] in 1977 at the University of Oregon suggests that the physical slowdown of body movement is not a uniform reduction of the total pattern but rather a dynamic change of the relationships of the body parts involved in the movement. This concept could be very important in optimizing the design of physical and psychological deterrents, and stop-action film analysis of relevant body movements should be considered in both the pre-design and prototype phases if possible. Physical exercise also increases response time to visual and auditory cues according to Szmodis [126], another design consideration.

Gunnar Borg [119], in a review of the psychological aspects of physical activities, offers several suggestions which may be relevant to security system design: (1) the relationship between subjective and objective work load intensities is such that equal intensity increases in work load over time will be perceived as being much greater than equal; (2) perceived exertion for arm work is greater than for equal intensity leg work; and (3) the function most sensitive to physical stress seems to be hand-arm steadiness.

Cerretelli [120], in an article concerning endurance, reminds us that psychological factors cannot increase the maximum power of an individual, but they can postpone the onset of fatigue. Thus, intense physical obstacles may be more effective than moderately difficult endurance-type obstacles. In a novel but somewhat related article, Morgan, et al. [125] attempted to affect the physical and psychological difficulty of a submaximal ergometer task by the use of hypnotic suggestion. He found that through hypnosis moderate work loads could be made physically and psychologically more difficult, but could not be made less difficult. One may conclude, then, that a physical security system with a physical exertion component should be designed to ensure maximum physical exertion of the target population.

Pain

Harmless forms of pain may be used effectively as a symbol or a warning, but would probably be unreliable as deterrents, due to the variability of pain thresholds and pain tolerance in the human population. In a study done by Mumford, Newton, and Ley [129] no correlation was found between personality variables and two measures of pain, pain perception threshold and pain tolerance level. This study did suggest, however, that men may

have a significantly higher pain tolerance than women. It was also suggested that severe sensations of pain can cause an "after-glow" of pain lasting from several seconds to several minutes.

A study by Woodrow, Friedman, Siegelau, and Collen in 1972, (cited in Carterette and Friedman [128]) concluded that: (1) pain tolerance decreases with age, especially in men, (2) men tolerate more pain than women at every age, (3) Whites tolerate more pain than Blacks, and Blacks more than Orientals. The greatest pain tolerance was shown by White males under 20 yr of age. Also cited by Carterette and Friedman, are several "cognitive dissonance" studies involving pain which suggest that those people who inflict pain minimize their own perception of similar pain. This implies that professional criminals and terrorists may have higher pain thresholds because of cognitive factors.

Carterette and Friedman [128] cite other studies which conclude that: 1) pain perception is less for people who voluntarily submit to painful stimulation, 2) pain is less for those who are expecting severe pain, 3) pain is less for persons in situations where they know the pain will occur and how intense it will be (uncertainty anxiety is concomitantly reduced).

Smell

The smell of blood, the "smell of fear," the smell of the enemy (as claimed by some Vietnam veterans) are familiar concepts to those with combat experience. As an adjunct to a system of sensory assaults, the use of smells may be an effective, though short-lived, psychological weapon. Two example actions are: 1) the presentation of unpleasant or nauseating smells, and 2) the presentation of emotion-arousing, intraspecific chemical signals or "pheromones" [132,135].

Many substances may be used for such sensory assaults. Some particularly unpleasant smells are those of ammonia, pyridine, diethyl sulphide, butyric acid, and hexane thiol [134]. A study by Rovee, Harris, and Topp [136] suggests that anxiety causes a decrement in olfactory sensitivity; therefore, whatever the choice of olfactory stimulus, it should be presented in a high concentration. In carrying out sensory assaults, it should also be noted that the sense of smell is quickly "fatigued" by strong olfactory stimuli; in fact, conscious perception of a strong smell wanes to about two thirds of its original magnitude in just a few minutes [132]. This adaptation to a strong olfactory stimulus does not appear to affect subsequent stimuli unless the sensory stimuli are similar in molecular structure. Mixtures of odors are generally less effective than single odors [132].

The second mode of action, the use of so-called "pheromones," is much more speculative. However, at least one author, William Cain [132], firmly believes that man has the capability to communicate by chemical secretion, but that it is an unpracticed and unrecognized talent. If man does have such a capability and its range of communications is comparable to that of other mammals, then we should be able to isolate pheromones through bioassay which convey messages of: territoriality, warning, defense, alarm, distress-signalling, and pain indication, to name only a few [135]. If such chemical signals can be isolated, and proper delivery systems designed, their worth as adjuncts to a general deterrence system may be more valuable than other sensory impacts because of their relative unobtrusiveness.

Cognitive and Perceptual Deterrents

Perceptual Processes

Although the open literature provides very little new information on perceptual distortion, creation of illusion, and camouflage, a few excellent

studies of visual perception were discovered. These studies indirectly suggest that it may be possible to create low cost distance and size illusions by such low technology methods as painting and lighting changes. Their effectiveness and feasibility as deterrents to nuclear theft can only be hypothesized, however, since no applicable documentation exists.

Perceptual distortion in other sensory modes is not well-documented, but may deserve further research. Tactile illusions in combination with visual field blanking may be especially worthy of consideration.

Information Overload

The literature search revealed no significant new information about information overload. The short bibliography which has been included reflects a few minor additions. Information overload, when sufficiently stressful, has been shown to cause: 1) a degradation in the ability to recall learned information [146]; 2) physiological changes such as pupil dilation, tachycardia, and hypertension, and changes in skin resistance and muscle tone [148]; 3) a tendency to respond in a stereotyped manner [149]; 4) perceptual distortions caused by overattention to details of the environment, including both relevant and irrelevant information [151]. Methods of information overload which seem to be most effective in producing stress (in addition to those mentioned by Kramer and Meguire, NBSIR 76-1007) are: 1) mixing unsolvable tasks into a group of solvable ones, 2) interruption of tasks, 3) giving false norms of performance, 4) given false feedback, 5) rapid pacing, 6) multiple tasks, and 7) using strong sensory inputs as background "noise" [149].

Personal Threat

The effect of personal threat seems to be widely variable depending on a number of factors such as: 1) individual differences in arousal state; 2) credibility of the threat; 3) immediacy; 4) the relevance of the threat to an individual's value system; and 5) the adversary's willingness to take risks, and his rationality in assessing risk. Overall, the use of personal threat must be viewed as inappropriate for highly motivated adversaries since they may be willing to suffer extreme mental and bodily injury, or even death, to attain their goals.

POST-EVENT DETERRENTS

Contingency Planning and Crisis Management

Several authors mentioned the need for a crisis management or contingency planning team [58,166,167]. Most felt a multidisciplinary approach was necessary and suggested that behavioral scientists be included either directly as negotiation specialists or indirectly as consultants.

The hypothesized effects of such a planning effort are: 1) adverse publicity and rumor can be minimized; 2) coherence and resolve will inspire the confidence of the public and instill respect or fear in the adversary; 3) physical and social damage can be minimized; and 4) reinforcing elements of scenarios can be minimized so that the probability of a nuclear-related incident will be lessened in the future.

SUMMARY

Although the literature indicates that psychological processes can be directly influenced by a variety of means, there is very little empirical data that is directly related to the question of psychological deterrence, and especially the deterrence of a highly motivated adversary.

A variety of techniques are presented, some of which may be feasible, others which may not. Only through further, specific applied research and field experimentation can the effectiveness of these hypothesized deterrents be tested. Implementation without further research could, in some cases, have disastrous effects e.g., a poorly thought-out public relations campaign could seriously injure the credibility of an agency, cause a loss of public confidence, and actually invite an attack rather than deter it.

IMPLICATIONS FOR FUTURE RESEARCH

Clearly, an extensive amount of definitive behavioral impact research should be undertaken to ascertain the deterrence values of many of the potential techniques and mechanisms cited in this report. For the present the hypothesized deterrents presented in this literature review remain speculative at best.

The next step in the process of designing a system of psychological deterrents should be a joint effort by behavioral scientists and physical security specialists to prioritize the hypothesized deterrents on the basis of feasibility and cost effectiveness, and then to determine their operational effectiveness through laboratory and field experimentation.

Table 1 presents a categorization of each of the hypothesized deterrents according to their assumed impact on potential adversaries. As can be seen in the table, the effect of most psychological deterrents on the "worst case" threat groups is, at best, uncertain. This situation should be rectified by initiating a program of experimentation and field validation with those deterrents found to be most appropriate to nuclear security systems.

BIBLIOGRAPHY

INTRUDER CHARACTERISTICS

- [1] Abnormal Psychology, Current Perspectives. DelMar, California: CRM Books, 1972.
- [2] Arblaster, A. Terrorism: myths, meaning, and morals. Political Studies, 1977, 25(3), 413-424.

This review provides excellent counterpoint to much of the terrorism literature. The author unabashedly critiques such well-known authors as J.B. Bell, Richard Clutterbuck, and Paul Wilkinson. Arblaster attacks the various definitions of terrorism and the assumptions that often underly them, such as the idea that terrorism is "revolutionary" and "aimed at the overthrow of governments," and that terrorism is "left-wing," Marxist, and essentially an intellectual and political form of violence. Other topics attacked as "myths" are: 1) terrorism is ineffective and 2) terrorists are psychologically warped or mentally deranged.

- [3] Beasley, M. Personal Communication, November 9, 1979.

Table 1. Level of threat/hypothesized psychological deterrent impact.

	Low			Medium			High			Worst-Case		
	Yes	No	U*	Yes	No	U*	Yes	No	U*	Yes	No	U*
Information Management & Public Relations			X			X		X			X	
Intelligence Gathering			X			X		X			X	
Training & Selection	X			X					X		X	
Noise & Vibration	X			X					X			X
Electromagnetic Radiation	X			X				X			X	
Temperature Effects	X			X					X			X
Strenuous Physical Exertion	X			X					X			X
Pain			X			X			X			X
Smell	X			X					X			X
Perceptual Distortion	X			X			X					X
Information Overload	X			X			X					X
Personal Threat	X			X					X			X
Contingency Planning and Crisis Management			X			X			X		X	

*Uncertain

- [4] Boozer, D. D. and Engi, D., Nuclear Facility Safeguards Systems Modeling Using Discrete Event Simulation. Albuquerque, N. Mex.: Sandia Laboratories, 1977.

This report describes a computer simulation study of the effectiveness of various safeguard systems for detecting the theft of nuclear materials. Though aimed primarily at sites concerned with special nuclear materials (SNM) rather than nuclear weapons, this report illustrates the need for modeling various insider strategies and implementation of appropriate safeguards if feasible.

- [5] Burnham, S. (Ed.) The Threat to Licensed Nuclear Facilities (NRC AT49-24-0129); Washington, D.C.: The Mitre Corp., 1975.

This paper discusses the potential threat to nuclear facilities from: 1) foreign governments, 2) foreign terrorists, 3) domestic dissidents, and 4) organized crime. The authors have included a short section on the psychology of members of potentially threatening groups, but it is speculative and undocumented.

- [6] Clark, R. C. Technological Terrorism. Old Greenwich, Conn.: Devin-Adair, 1979.

The author describes scenarios of superviolence and sabotage that are now possible because of technological progress. Included are sections on nuclear destruction, chemical and biological weapons, and computer sabotage.

- [7] Cooper, H. H., The Terrorist and the victim. Victimology: An International Journal. 1976. I(2), 229-239.

Cooper analyses different types of terrorism and their victims. He also discusses the dehumanization process by which terrorists rationalize the murder of their victims. He implies that once-removed techniques of terror such as bombing are easier to perform. Cooper feels that a "no negotiations" hostage policy doubles terror by implying that not only have the terrorists dehumanized their victim but society has done so as well. Cooper feels that there are few terrorists who are totally devoid of human concern and that "the problem for those concerned with victimology and those entrusted with tactical responses to terrorism is how to fan the spark of humanity to a blaze." He offers no suggestion as to how this goal might be attained.

- [8] DeLeon, P., Jenkins, B., Kellen, K., and Krofcheck, J., Attributes of Potential Criminal Adversaries of U.S. Nuclear Programs. Santa Monica, Calif.: The Rand Corporation, 1978.

The authors examine analogous crimes for commonalities which may have relevance to the nuclear theft situation. Discussed are: goals, planning skill, resources, transportation, access, and amount of time required to complete an action.

- [9] DeNike, L. D., Radioactive malevolence. Science and Public Affairs, Feb. 1974, 16-20.

The author discusses the likely interaction of nuclear technology and the predisposition of humans to evil. Two points are made in the article: 1) reliance on human scruples is impossible and 2) it is impossible to use psychological profiles in the screening of individuals. The article considers military, as well as terrorist attacks upon nuclear installations.

- [10] Federal Bureau of Investigation. Uniform Crime Reports for the United States, 1977, Washington, D.C.: U.S. Government Printing Office, 1978.

- [11] Fine, A. M., Attributes of potential adversaries to U.S. nuclear programs. The Role of Behavioral Science in Physical Security, Proceedings of the Second Annual Symposium, March 23-24, 1977 (NBS Special Publication 480-32). Washington, D.C.: U.S. Government Printing Office, 1978.

This work is a brief overview of the Rand Corporation's attempts to profile the adversary through the use of analogous behaviors such as crime and terrorism.

- [12] Frank, J. D., Some psychological determinants of violence and its control. Australian and New Zealand Journal of Psychiatry, 1972, 6(3), 158-164.

Dr. Frank dichotomizes violence into instrumental, or goal-oriented, violence, and expressive violence, which is gratifying in and of itself. Dr. Frank would control instrumental violence by developing non-destructive alternatives for satisfying specific goals. Expressive violence could be minimized by developing vicarious and symbolic forms of violence such as spectator sports. Both instrumental and expressive forms of violence could be minimized through the socialization process--"violent behavior obeys the same laws of learning as other forms of behavior..."

- [13] Grabowsky, P. N., The urban context of political terrorism. In Stohl, E. (Ed.) The Politics of Terrorism. New York: Marcel Dekker, Inc., 1979.

In this work the author argues that terrorism has become an increasingly urban tactic. The urban arena provides the terrorist with more high technology targets, better communications, better transportation possibilities, and a number of other advantages. Specific points of interest: 1) urban terrorists highly value the female operative when secrecy and cover are imperative; 2) indiscriminate violence is most commonly used in bicultural societies--this action provokes retaliation and may cause further polarization within a bicultural society; and 3) secrecy and rumor mongering are most effective in repressive societies.

- [14] Guttman, H. E., Probability of an In-house Malevolent Psychotic. Alburquerque, N. Mex.: Sandia Laboratories (SC-TM-68-681), 1968.

This is a short technical memorandum which is, unfortunately, not widely available at the present time. The assumptions underlying all component estimates are openly stated and can be critically evaluated. Although the practical utility of quantifying the probability of a rare event is questionable - witness the "Rasmussen Report" and the Three Mile Island incident - quantification such as this does, at least, demand a hard look at the assumptions that underpin nuclear security.

Guttman's estimate of the probability that a malevolent psychotic would be employed at this lab (Sandia) and would attempt a destructive act was 2.5×10^{-7} with a "two-man rule" of access.

- [15] Haskell, M. R. and Yablonsky, L., Crime and Delinquency. Chicago: Rand McNally & Co., 1971.
- [16] Hubbard, D. G., The Skyjacker: his flights of fantasy. New York: Macmillan Co., 1971.

The author uses data gathered in personal interviews with skyjackers to document his hypotheses about their personalities. Hubbard typifies the skyjacker as an inadequate personality who skyjacks to acquire dignity, to affirm that he belongs to the human race, to perform a courageous, symbolic act and thereby, absolve himself of his sense of worthlessness. Hubbard

suggests five tactics for controlling skyjacking, three of which may be applicable to other types of crime such as nuclear weapon hostage situations: 1) "broad dissemination of the findings of medical research...stressing the involvement of sexual inadequacy in the crime"; 2) addition of more women to essentially male organizations in order to downplay the "machismo" or male aura associated with them; and 3) eliminate the death penalty while increasing the probability of incarceration and treatment.

- [17] Jeffrey, C. R., Criminal behavior and the physical environment. American Behavioral Scientist, 1976, 20(20), 149-288.

The author seeks to establish a model of criminal behavior which takes into account physiological and environmental psychology. One of his main points is that the deterrence effect of punishment is nullified in some sectors of the population by reason of inherited characteristics. These individuals, whom he calls sociopaths, simply do not "condition" to a fear of pain.

- [18] Jenkins, B. M., Will terrorists go nuclear? The Rand Corporation, Santa Monica, Calif., Nov. 1975. (NTIS No. AD-A026 579).

This report discusses the potential threat posed by terrorists, including the creation of hoaxes, acts of sabotage, occupation or seizure of nuclear facilities, thefts of nuclear materials, manufacture of nuclear weapons, and the detonation or threatened detonation of nuclear devices. Author gives his opinion as to the most likely scenarios and the most likely perpetrators. The author feels that terrorists are, generally rational people who see violence as an effective way to attract attention and inspire fear.

- [19] Klausner, S. Z. (Ed.), Why Man Takes Chances. New York: Doubleday & Co., 1968.

This book contains several studies in stress-seeking. Three studies attempt an emotional analysis of stress-seekers. Klausner describes the character attributes and personality of stress-seekers, with particular attention given to the social reinforcement received by stress-seekers.

- [20] Leachman, R. B., Althoff, P., (eds)., Preventing Nuclear Theft: Guidelines for Industry and Government. New York: Praeger, 1972.

The book contains papers and summaries of discussions presented at the Symposium on Implementing Nuclear Safeguards, sponsored by the Diversion Safeguards Program at Kansas State University. The contents include papers on: 1) Safeguards overview, 2) National safeguards systems, 3) Social psychological studies of the safeguards problem, 4) Thefts, criminology, and jurisdiction, and 5) Who are the enemy.

- [21] Mabry, R. C., Nuclear Theft: Real and Imagined Dangers Naval Postgraduate School, Monterey, Calif., March 1976 (Defense Documentation Center No. ADA 028855).

This thesis examines the possibility of theft of nuclear material by non-governmental people or groups. It discusses possible motivations for committing nuclear theft. The capability of potential thieves is evaluated as well as site vulnerability and safeguards effectiveness.

- [22] Mallin, J. (Ed.) Terror and Urban Guerrillas, A Study of Tactics and Documents. Coral Gables, Fla.: University of Miami Press, 1971.

This book discusses terrorism and special tactics for urban guerrillas. Chapter 5 is a minimanual for the urban guerrilla. It not only describes

the characteristics of the urban guerrilla, but also lists techniques that the guerrilla should be familiar with. Chapter 6 answers 150 questions that a guerrilla might need to know.

- [23] McKnight, G., The Terrorist Mind. New York: Bobbs-Merrill, 1974.

McKnight has established contacts with terrorists around the world. Articles in the book include: "Red Army Member: No Regrets," "Belfast's Bloody Guns: Both Sides' Terrorists Regret Innocent Deaths, But ...," and "Learning the Secrets of Black September." Although his interviews are very unstructured, they do offer some insights into the psychology of various members of terrorist groups.

- [24] Menninger, K., Whatever Became of Sin? New York: Hawthorne Books, 1975.

In chapter 7, Menninger discusses group dynamics, and sin as a collective irresponsibility. The word "group-think" is defined as a kind of self-deception in which responsibility for an action is diffused among the members of a group to such an extent that no one individual retains responsibility for actions taken. The implications of "group-think" for guilt, accountability, and punishment are also discussed. An interesting discussion of "police as moral leaders" is included in a later chapter.

- [25] Mickolus, E. F., Statistical Approaches to the Study of Terrorism. In Alexander, Y. and Finger, S. M. (Eds.), Terrorism: interdisciplinary perpectives. New York: John Jay Press, 1977.

Mickolus discusses the methodology, tentative findings, and future applications of his statistical approach to the study of terrorism, project "ITERATE" (International Terrorism: Attributes of Terrorist Events). In an appendix he discusses other similar approaches, including the works of Brian Jenkins and others at the Rand Corp., Ted Robert Gurr, and Ernest Evans. Mickolus' approach is well organized and thought provoking. Specific findings of interest: 1) "indirect" attacks such as bombings far outnumber personal confrontations; and 2) the most frequently mentioned terrorist motivations are the release of political prisoners, monetary ransom, and the combination of the two.

- [26] Mickolus, E. F., Written communication, July 19, 1977. Advanced Research Projects Agency: Arlington, Va. 22209.

This report covers all aspects of superviolence or the illegitimate, unsanctioned use of mass destruction weapons. The report investigates the problem and the background of superviolence including the political, psychological, and criminal motives. Some known superviolent incidents are summarized. The development of an illicit nuclear weapon is investigated. Finally the threat process itself is reviewed and some solutions to the superviolence problem are identified.

- [27] Middendorf, W., The personality of the terrorist, part 2, the female terrorist. Kriminalistik, 1976, 30(8), 357-363. (German. Unpublished translation by A. Perrey).

This report deals with the role of the female in terrorism. Examples are drawn from various countries of the world, including Ireland, West Germany, the Soviet Union, and the United States. The author notes that the personality of the terrorist is difficult to characterize because of the almost universal refusal of captured terrorists to be interviewed by behavioral scientists.

The author feels that the use of terrorism can never be fully explained through rational motivations since violence is only one of many ways to

attain a goal, - there must be aggressive tendencies intertwined with the more rational motivations. He also implies, that terrorist activities often involve widely disparate personality types ranging from schoolteachers to professional criminals. He further states that psychopathic individuals are attracted to terrorist groups because of the sensationalism which surrounds such groups.

Middendorf feels that the aspect of "remoteness" or "distance" is an important aspect of terroristic violence. He states that the willingness to kill depends on: 1) the distance (physical and psychological) between the assailant and the victim; 2) the extent to which responsibility and guilt is diffused among members of the group; and 3) the ability of the perpetrators to realistically assess the consequences of a particular act.

Middendorf makes one relevant recommendation, that is, that women should be involved in all aspects of police activity so that we can benefit from their insights.

- [28] Morf, G., Terror in Quebec: Case Studies of the FLQ. Toronto: Irvin & Co., 1970.

The author presents a demographic/biographical history of the FLQ (Front de la Libération Québécois) since 1963. The book is based on personal interviews with members of the FLQ. Typically, they were young, that is, under 30, average or above average in intelligence, relatively low in education, lacking in patience, and socially and emotionally unstable.

- [29] National Advisory Committee on Criminal Justice Standards and Goals. Disorders and terrorism: Report of the task force on disorders and terrorism. Washington, D.C.: U.S. Department of Justice, Law Enforcement Assistance Administration, Dec. 1976.

This report covers standards that deal with all types of disorders and terrorism. Proposals are made for training police and law enforcement agencies in preventive measures that can be taken against mass violence. The task force gives recommendations on the role the courts should play. Also included are suggestions for the news media. The appendices contain articles dealing with an overview of international terrorism.

The appendices also contain information directly related to terrorist characteristics. This volume contains an excellent, very comprehensive chronology of incidents of terrorism, quasi-terrorism, and political violence which was compiled by Marcia McKnight Trick.

- [30] National Foreign Assessment Center, International Terrorism in 1978, Washington, D.C.: Central Intelligence Agency, March 1979. (Available through NTIS).

This article presents statistics and demographics of terrorist incidents which occurred during the decade, 1968-1978. Bombing and incendiary attacks remain the most common mode of terrorism because of the reduced risk they pose to the perpetrator. Countermeasures are briefly discussed, but the majority of this article deals with a description of incidents and perpetrators.

- [31] Page, J. D., Psychopathology. Chicago: Aldine-Atherton, 1971.

- [32] Pickrel, E., Federal Aviation Administration's behavioral research program for defense against hijacking. The Role of Behavioral Science in Physical Security, Proceedings of the First Annual Symposium, April 29-30, 1976 (NBS Special Publication 480-24). Washington, D.C.: U.S. Government Printing Office, 1977.

This work is a very brief history of the FAA's efforts to deter hijacking. Included is a discussion of the use of a behavioral profile to screen airline passengers for potential hijackers.

- [33] Rappoport, L. and Pettinelli, J. D., Social psychological studies of the safeguards problem. In Leachman, R. B. and Althoff, P. (Eds.) Preventing Nuclear Theft: Guidelines for Industry and Government. New York: Praeger Publishers, 1972.

This work addresses issues of: 1) points of vulnerability, 2) probable adversaries to nuclear security, 3) analogous crimes, and 4) simulation. In the discussion following this chapter, the shortcomings of profiles and typologies were briefly discussed.

- [34] Russell, C. A. and Miller, B. H., Profile of a Terrorist. Military Review, 1977, 57 (21), 21-34.

This is an excellent study of eighteen urban terrorist groups. Topics included in this discussion are: age, sex, marital status, geographic origin (rural versus urban), social and economic background, education or occupation, method/place of recruitment, and political philosophy.

- [35] Security of public facilities and systems, Standard 4.8 Commentary. In Disorders and Terrorism, Report of the Task Force on Disorders and Terrorism, Washington, D.C.: U.S. Department of Justice, Law Enforcement Assistance Administration, 1976.

In this brief treatment of building security it is stated that women are less suspected, less frequently searched, and less thoroughly searched than male suspects.

- [36] Slomich, S. J. and Kantor, R. E., Social psychopathology of political assassination. Bulletin of Atomic Scientists, 1969, 25(3), 9-12.

Dr. Slomich characterizes political assassins as: 1) "dispossessed elements of the lower middle classes"; 2) having strong unfulfilled sex drives; 3) intensely envious; 4) alienated from society; 5) afflicted with hopelessness and self-destructive drives; 6) generally apathetic, but exhibiting sporadic outbursts of violence. His discussion of the typical assassin sounds very much like David Hubbard's characterization of skyjackers [16].

- [37] Stohl, M. (Ed.). The Politics of Terrorism, New York: Marcel Dekker, 1979.

This book is a collection of essays on the process of political terrorism. No one theoretical position is taken. Stohl, in his introduction, discusses eight myths of terrorism, which are particularly interesting. He then divides the process of political terrorism into three component parts: "(1) the act or threat of violence, (2) the emotional reaction to such an act or threat, and (3) the social effects resultant from the acts and reaction." The remainder of the essays deal with the concepts, theories, ideologies, and sources of terrorism.

- [38] Study suggests predictable criminal behavior. Trial, The National Legal Magazine, Oct. 1977, 13, 11-13.

This article summarizes the preliminary findings of a Rand Corporation research program funded by LEAA. In-depth interviews of 49 armed robbers and criminal record searching were the methodologies utilized by the research team. The major finding to date was that habitual criminals may be distinguishable from intermittent criminals. One particular finding of interest among several listed was "offenders who found themselves frustrated

in accomplishing a crime because of tight security said they merely substituted a secondary target..."

- [39] Sykes, G. M. and Drabek, T. E., Law and the Lawless, A Reader in Criminology. New York: Random House, 1969.
- [40] Toch, H., Violent Men, An Inquiry into the Psychology of Violence. Chicago: Aldine Publishing Co., 1969.

Using peer interviews Toch has gathered data on violent men which can be useful in two ways: 1) as analogs to violent groups and 2) in analyzing the psychological motives of specific individuals and group members. He includes chapters on "The Violent Incident as a Unit of Study," "The Violence-Prone Person: A Typology," and "Some Implications" for reducing individual and collective violence.

In his typology, Toch states that the most probable motivation to violence is intense fear. Concerning group violence, he feels that participants must be taught other means of achieving their goals; to quote, "Violence cannot be remedied when there is in fact no other way to achieve dignity and status."

INFORMATION MANAGEMENT AND PUBLIC RELATIONS

- [41] Alexander, Y. and Finger, S. M., (Eds.). Terrorism: Interdisciplinary Perspectives. New York: John Jay Press, 1977.

This book is an excellent collection of articles and includes a good treatment of the subject of terrorism and the media (chapter 4). In chapter 1, Baljit Singh covers strategies, tactics, and targets, including a short section on the psychology of specific terrorists, their goals and motives. In chapter 4, H. H. A. Cooper, Bernard Johnpoll, and Yonan Alexander present discussions of the media, especially concerning the issue of news suppression. In chapter 4 future implications are addressed in articles by Edward Mickolus, Joseph Margolin, and Martha Crenshaw Hutchinson. An extensive bibliography is included.

- [42] Baldonado, O. C., et al. Safeguards Systems Concepts for Nuclear Material Transportation, Final Report (NUREG-0335). McLean, Va.: System Development Corp., Sept. 1977. (NTIS No. PB272-496).

Deterrence is viewed as an a priori method of dealing with an attack, implemented for the most part through publicity campaigns. Other methods suggested include infiltration and "planting information." Speculation about types of adversary, motivation, and likely scenarios is given in chapter 3. The vulnerability of nuclear materials in the transport cycle is discussed in chapter 4. Recommendations are given in chapter 5 -- deterrence is described as the first subsystem and would include centrally-controlled publicity concerning: 1) the invulnerability of safeguards; 2) the consequences to be faced by potential adversaries; 3) the "hard-line" approach to negotiating demands; 4) an image of alertness, efficiency, and impregnability; 5) special legal penalties for attacks on nuclear shipments. This is probably the most comprehensive treatment of the transport cycle available.

- [43] Blair, B. G. and Brewer, G. D., The terrorist threat to world nuclear programs. Journal of Conflict Resolution, 1977, 21(3), 379-403.

After a brief introduction detailing the problematic history of U.S. safeguards policy, the authors highlight some of the vulnerabilities of the nuclear weapons security program, using the Minuteman Intercontinental Ballistic Missile as a specific example. Among their recommendations are:

1) installation of "permissive action links," that is, coded arming devices; 2) preaccess screening improvements such as more rigid clearance standards and better physical and procedural identification techniques; 3) suspension of visitor access; 4) facilitate public debate and research about nuclear safeguards while declassifying the information needed to carry on such debate and research.

- [44] Chauncey, R., Deterrence: certainty, severity, and skyjacking. Criminology, 1975, 12 (Feb.), 467-473.

Chauncey analyzes rates of skyjacking attempts to determine the effects of certainty and severity of punishment. It was found that changes in certainty produced significant reductions in rate, while changes in severity of punishment yielded minimal or ambiguous results. Additional arguments to support this conclusion are given as: 1) the most severe punishment, death, has not been shown to be an effective threat, and may in some cases be an extra enticement to a crime like skyjacking in which some perpetrators show "clear suicidal intent" [16]; 2) total certainty of punishment will theoretically yield total deterrence, total severity will not because total severity is unachievable; 3) a person who carefully plans a crime also plans to escape detection and punishment, therefore no consequence will be a deterrent because the perpetrator believes that he or she will escape the consequences of his/her criminal act; thus, we must modify the belief and not the consequences.

- [45] Dror, Y., Crazy States: A Counter-Conventional Strategic Issue. Lexington, Mass.: Heath, 1971.

This is a highly theoretical treatment of various political entities, including terrorist groups. The author discusses various counterstrategies including the withholding of reward in the form of capitulation. Dror gives good definition of assumptions underlying deterrence: 1) rationality of adversary; 2) our credibility to the adversary; 3) threats to opposition are relevant to their value system; 4) threat must be above adversaries risk propensity level - 4a) threat should be aimed at values highly regarded by adversary; 4b) credibility must be reinforced by decisive action; 4c) deterrence must be assured through visible, irreversible commitments.

- [46] Geerken, M. and Gove, W. R., Deterrence, overload, and incapacitation: an empirical evaluation. Social Forces, 1977, 56(2), 424-447.

The authors, while addressing the theoretical side of deterrence, give a good definition of the underlying assumptions: 1) rationality of the adversary, and 2) profit-maximizing motive (see Y. Dror [45] for a more extensive treatment). The deterrent in question is certainty of punishment; the conclusion is that it is effective with rational crimes (that is, property crimes or what J. D. Frank [12] calls "instrumental violence"), but certainty of punishment is not as effective in deterring crimes of passion (murder, assault, and so forth - Dr. Frank's "expressive violence").

- [47] National Advisory Committee on Criminal Justice Standards and Goals. Disorders and Terrorism: Report of the Task on Disorders and Terrorism. Washington, D.C.: U.S. Department of Justice, Law Enforcement Assistance Administration, 1976.

Sections of this report which are relevant to information management and public relations are the following standards and their respective commentaries: 4.10, Civil Authorities and the Media; 6.10, Deterrence of Terrorism and Quasi-Terrorism; 6.12, Response to Terroristic Threats; 6.17, Avoiding the Spread of Extraordinary Violence; 6.25, 7.10, and 8.7, Relations with the News Media; 10.1, Nonviolent Protest Alternatives; 10.2 News and Entertainment Media Responsibility for the Prevention of

Extraordinary Violence; and 10.8, News Media Self-Regulation in Contemporaneous Coverage of Terrorism and Disorder.

[48] Ibid.

Several of the goals and standards discussed in this report are relevant to the subject of community relations. In particular, see: Goals 4.1, Improving the Social Climate, and 4.2, Developing the Community Response; Standards 4.3, Facilitating Peaceful Demonstration; 4.8, Security of Public Facilities and Systems; Goal 10.1, Locating Community Responsibility for the Prevention of Extraordinary Violence; Standards 10.1, Nonviolent Protest Alternatives; 10.3, Community Cooperation with Law Enforcement and Prevention Efforts; and 10.7, Community Efforts to Prevent the Spread of Extraordinary Violence.

[49] Palmer, L. I., Adenaes and the theory of deterrence, a review article of Punishment and Deterrence by Johannes Andenaes. The Journal of Criminal Law and Criminology, 1975, 66(1), 106-109.

Palmer discusses general deterrence which, according to Andenaes, is "the ability of the criminal law and its enforcement to make citizens law-abiding." This definition removes the forces of deterrence from a minority of law violators who have been apprehended, and broadens it to encompass the citizenry in general. Palmer also discussed the dimensions of deterrence, specifically, the threat of punishment, the fear of punishment, the perceived risk of detection, and the adjunct social effects of the moralizing and educative function of the law. These last two functions have probably been underutilized because of the fear that moralizing and education may easily become propagandizing. Andenaes feels that we must face the fears and reality inherent to the concept of deterrence if we are to deal with them honestly and ethically.

[50] Smith, D. C., Mafia: the prototypical alien conspiracy. Annals, American Academy of Political and Social Science, Jan. 1976, 423, 75-88.

This paper addresses the problem of America's obsession with conspiracies. "Mafia" is followed from inception to present and is deemed to be a construct of law-enforcers, government officials, and media people, and based on a misinterpretation of fact.

The tendency of the American public to accept conspiracy theories and to fabricate alien conspiracies where none exist is a point which small groups of terrorists can capitalize upon. A group of three or four people can seem like an army if their media impact and terrorism are properly combined.

[51] Tittle, C. R. and Rowe, A. R., Certainty of arrest and crime rates: a further test of the deterrence hypothesis. Social Forces, 1974, 52(4), 455-462.

Tittle and Rowe examine the relationship of certainty of arrest to crime rates by statistically analyzing data from Uniform Crime Reports. They conclude that there is a point of criticality above which certainty of arrest must go before it becomes an effective factor in deterrence, in this case, 30% certainty was the approximate breakover point.

The authors also discuss motivation as a necessary but not sufficient component of deviant behavior - many may have the motivation to engage in deviant behavior, but only those who do not fear the sanctions will engage in such behavior.

This article reiterates the importance of communicating to potential criminal the high certainty of detection, arrest, and punishment involved in

an unlawful act, and also, the importance of maintaining sanctions which are relevant to the values of a broad base of the population or which are flexible enough to be tailored to the motivations of specific, high-threat groups within the population.

INTELLIGENCE GATHERING

- [52] Barclay, C. N., Countermeasures against the urban guerrilla. Military Review, 1972, 52(1), 83-90.

The author reviews the role of the army in internal security, using the situation in Northern Ireland as an example. He implies that an obtrusive military presence is eventually resented by both the dissident and assenting groups. His discussion of countermeasures is very pragmatic and includes: 1) the use of well-trained troops and reserves; 2) the gathering of specific and timely intelligence; 3) fostering an attitude of cooperation with local police forces; and 4) developing a cooperative attitude with the general public.

- [53] Central Intelligence Agency. International and Transnational Terrorism: Diagnosis and Prognosis. Washington, D.C.: Library of Congress, DOCEX Project, Exchange and Gift Division, 1976.

This is a good, though slightly outdated, analysis of terrorism. It includes extensive statistical and demographic data. Five primary reasons for the increase in terrorism are listed: 1) technological advances give terrorists new capabilities; 2) new technology has given terrorists new, more vulnerable targets such as power grids and jumbo jets; 3) a permissive political environment has fostered a worldwide revolutionary atmosphere; 4) terrorists are being better funded by sponsoring nations and states; and 5) overall economic conditions have led to dissatisfaction with the status quo. Timely intelligence, multidisciplinary analytical support, and extensive inter- and intra-state coordination are felt to be critical. The report presents the possibility of nations using terrorism as "surrogate warfare." In a one-page treatment of the nuclear threat, the authors speculate that a barricade of a weapons storage bunker or the threat of broadcasting chemical, biological, or radiological prisons are more likely than a nuclear bomb extortion scenario.

- [54] Clutterbuck, R., Living with Terrorism, New Rochelle, N.Y.: Arlington House Publishers, 1976.

Using case studies of specific terrorist groups, the author attempts to illustrate terrorist tactics, strategies, motivations, and goals. Especially interesting is chapter 12 which deals with the psychology and motivation of terrorists. He also discusses the implications of an individual's first act of destruction or murder on his subsequent committedness.

In chapter 13, "Prevention and Cure," Clutterbuck calls certainty of detection, conviction, and punishment the most effective deterrent. He argues succinctly against capital punishment and for better police intelligence and development of public cooperation. The pro and cons of various control measures such as passports and identification cards are also discussed. A section on the government and the media is included. In his concluding chapter Clutterbuck warns against over-reaction and suggests that the prevention of terrorism "...lies rather in patiently fostering a climate of opinion..." in the populace, especially the universities.

- [55] Elliott, J. D. and Gibson, L. K., Contemporary Terrorism, Selected Readings. Gaithersburg, Md.: International Association of Chiefs of Police, 1978.

This collection of articles, essays, and lectures is probably the most comprehensive work on terrorism presently available. Besides the usual articles on terrorist strategies, tactics, and characteristics, there are several articles which address nuclear terrorism in particular.

Also of interest was a large section devoted to the response to terrorism, especially that of the news media. John Wolf makes several recommendations including the development of a "greater degree of cooperation between federal intelligence agencies and the news media, in the form of an educational effort..." to alert all concerned that terrorism is contagious and criminal, not heroic or idealistic. He cites the need for surveillance and other intelligence gathering operations, and the need for a federally run public education program on terrorism. H. H. A. Cooper details intelligence and counter-intelligence techniques for combating terrorism. Daniel P. Moynihan provides some counterpoint, arguing: 1) that the threat of punishment does not deter, and 2) that intelligence operations are generally not cost effective. A short annotated bibliography is included.

- [56] Kupperman, R. H., Facing Tomorrow's Terrorist Incident Today. Washington, D.C.: U.S. Government Printing Office (Stock No. 027-000-00614-1), 1977.

The author suggests three lines of defense: 1) intelligence, 2) hardening targets, and 3) crisis management. He discusses chemical tagging as a possible, cost-effective deterrent to thefts of military stocks of all kinds, including small arms. The suggested chemical tags could be detected either with electronic "sniffers" or by trained dogs.

- [57] National Advisory Committee on Criminal Justice Standards and Goals. Disorders and Terrorism: Report of the Task Force on Disorders and Terrorism. Washington, D.C.: U.S. Department of Justice, Law Enforcement Assistance Administration, 1976.

This report presents several standards which are relevant to the subject of intelligence gathering. They are standards: 4.9, Antiassassination Measures; 5.3, The Intelligence Function; 5.4, Other Counterterrorist Measures Undertaken by Intelligence Units or Agencies; 6.4, Self-regulation of Police Intelligence Operations; 6.5, Police Specialization for Prevention and Control of Extraordinary Violence; 7.2, Judicial Regulation of Intelligence Gathering; and 8.2, Information Systems.

- [58] Wolf, J. B., Police intelligence focus for counter-terrorist operations. Police Journal, 1976, 49(1), 19-27.

Dr. Wolf suggests that highly developed police intelligence systems are necessary to deter and combat terrorist operations. The special problems of intelligence collection, storage, and dissemination are discussed. Special operational divisions such as S.W.A.T. type teams and waterfront patrols are also discussed. The deterrence effect of intelligence, special teams, and so forth is only assumed, not documented.

TRAINING AND SELECTION OF PERSONNEL

- [59] Calvert-Boyanowsky, J. and Leventhal, H., The role of information in attenuating behavioral responses to stress. Journal of Personality and Social Psychology, 1975, 32(2), 214-221.

This discussion suggests that arousal symptoms may be reduced by "warning" subjects or by giving them prior information about the arousal state which they may expect to occur. This could be a useful part of the

training regimen for security guards as a preparation for response to a critical event.

- [60] Galloway, S. L., Response force selection and training. In Kramer, J. (Ed.) The Role of Behavioral Science in Physical Security, Proceedings of the Second Annual Symposium, March 23-24, 1977 (NBS Special Publication 480-32). Washington, D.C.: U.S. Government Printing Office, 1978.

The author discusses many of the problems involved in proper selection and training of a response force. His recommendations include: development of a team concept, cross training of security duties among response force members, frequent in-service training, periodic off-site training, and general development of an "elite force" competency and motivation. Since his discussion is limited to the private sector, a few of Galloway's assumptions and recommendations are not generalizable to military applications.

- [61] Heckman, R. W., Groner, D. M., Dunnette, M. D., and Johnson, P. D., Development of Psychiatric Standards for Police Selection, Minneapolis, Minn.: Personal Decisions, Inc., 1972. (NTIS No. PB215-534).

The authors discuss a variety of screening and selection devices. The need for development of good, job-related performance criteria is emphasized. The authors conclude that no single test instrument is a good predictor of performance, but that much of the problem is the lack of consistent performance measures. The final implication is that a multipredictor/multidimensional criterion selection process should be developed.

- [62] International Association of Chiefs of Police, Research Division, Ambush Attacks - A Risk Reduction Manual for Police. Washington, D.C.: U.S. Department of Justice, Law Enforcement Assistance Administration, 1974 (NCJRS No. .030021).

This report is aimed at civilian police forces rather than military forces, however, the expert opinion contained herein is nonetheless applicable to military security also. Several sections have an indirect relevance to psychological deterrence - they are: the use of two-man teams/back-up teams; the use of dogs; training in defensive tactics; collection and use of intelligence; and, finally, physical conditioning.

- [63] National Advisory Committee on Criminal Justice Standards and Goals. Disorders and Terrorism: Report of the Task Force on Disorders and Terrorism. Washington, D.C.: U.S. Department of Justice, Law Enforcement Assistance Administration, 1976.

Concerning selection and training of personnel, the following standards were deemed relevant: 6.1, General Recruitment and Training; 6.8, Tactical Management of Mass Disorders in Progress; 6.13, Tactical Responses to Terroristic Acts; 6.14, Tactical Responses to Quasi-Terroristic Acts; and 6.15, Use of Force in Tactical Response to Disorder, Terrorism, and Quasi-Terrorism. Besides the obvious tactical skills needed, it is suggested that police officers/security personnel be trained in communications skills and community relations. Standard 10.10 addresses some rules of behavior for those who may find themselves in the role of victim or hostage.

- [64] NiCastro, J. and Kendrick, H., Some ideas on structuring the problem of collusion. In Kramer, J. (Ed.) The Role of Behavioral Science in Physical Security, Proceedings of the Second Annual Symposium, March 23-24, 1977 (NBS Special Publication 480-32). Washington, D.C.: U.S. Government Printing Office, 1978.

The authors suggest several methods of deterring collusion including: pre-employment polygraph tests and "Q" clearances, random rotation of duties, two-man rule, isolation, reliability checks, spot inspections, and finally, the development of esprit de corps. The authors emphasize that the guard force should not be treated as untrustworthy and that the feeling of supervisory suppression should be minimized.

- [65] Private Security Advisory Council, Prevention of Terroristic Crimes. Washington, D.C.: U.S. Department of Justice, Law Enforcement Assistance Administration, 1976.

This publication outlines various ways by which individuals may deter and deal with terroristic acts. Included are plans of action, guidelines, and checklists for dealing with kidnap and with extortion. Some of the deterrents discussed here are already in effect at nuclear sites. The deterrent effect of training personnel in dealing with threats to self and family is not known, but may have some deterrent impact simply because it implies a reduction of vulnerability. Richard Clutterbuck in Living with Terrorism [54] lists similar personal protection methods among his recommended deterrents.

NOISE AND VIBRATION

- [66] Cohen, H. H., Wasserman, D. E., and Hornuug, R. W., Human performance and transmissability under sinusoidal and mixed vertical vibration, Ergonomics, 1977, 20, 3, 207-216.
- [67] Davies, D. R. and Jones, D. M., The effects of noise and incentives upon attention in short-term memory. British Journal of Psychology, 1975, 66(1), 61-68.
- [68] Drazin, D. G., Factors affecting vision during vibration. Cited in Kraiss and Moraal (Eds.) Introduction to Human Engineering, Verlag TUV Rheinland GmbH, Bonn, Germany, 1976. (p. 235).
- [69] Frankenhauser, M. and Lundberg, U., Immediate and delayed effects of noise on performance and arousal. Reports from the Psychological Laboratories, University of Stockholm, 1973, No. 407, 1-7.
- [70] Green, J. A., Effectivity of antimotion sickness drugs during artificial gravity simulations. Aerospace Medicine, 1973, 44(11), 1255-1261.
- [71] Grether, W. F., Harris, C. S., Mohr, G. C., Nixon, C. W., Ohlbaum, M., Sommer, H. C., Thaler, V. H., Veghte, J. H., Effects of combined heat, noise, and vibration stress on human performance and physiological functions. Aerospace Medicine, 1971, 42(10), 1092-1097 in Foundations of Space Biology and Medicine, Washington, D.C.: NASA, 1975. (Chapter 9, Noise and Vibration, by von Gierke, Nixon, and Guignard, p. 371.)
- [72] Guignard, J. C., Vibration, in Guignard, J. C. and King, P. F., Aeromedical Aspects of Vibration and Noise, NATO, AGARD-ograph No. 151, cited in Kraiss, K. F., and Moraal, Introduction to Human Engineering, Verlag TUV Rheinland GmbH, Bonn, Germany, 1976. (p. 234).
- [73] Gulian, E., Noise as a stressing agent. Studia Psychologica, 1974, 16(3), 160-168.

- [74] Harris, C. S., Sommer, H. C., and Johnson, D. L., Review of the effects of infrasound on man. Aviation, Space, and Environmental Medicine, 1976, 47(4), 430-434.
- [75] Hasan, J., Biomedical Aspects of Low-Frequency Vibration, Work-Environment-Health, 1970, 6(1), 19-45.
- [76] Lewis, C. H., and Griffin, M. J., A review of the effects of vibration on visual acuity and continuous manual control, Part I: visual acuity. Journal of Sound and Vibration, 1978, 56(3), 383-413.
- [77] Loeb, M., Jones, P. D., and Cohen, A., Effects of Noise on Non-auditory Sensory Functions and Performance. Louisville, Ky.: University of Louisville, April 1976. (NTIS No. PB-266247).
- [78] Malcolm, R., Human Responses to Vestibular Stimulation and Some Implications to the Flight Environment. PhD. Thesis, McGill Univ., cited in Reason, J. T. and Brand, J. J., Motion Sickness, N.Y.: Academic Press, 1975.
- [79] Morgan, B. J. T., Chambers, S. M., and Morton, J., Acoustic confusion of digits in memory and recognition. Perception and Psychophysics, 1973, 14(2), 375-383.

This study could have direct use in the design of acoustically cued combinations, codes, and so forth. The authors discuss the factors which seem to cause confusion of certain digits, and also which digits are most often confused with each other under noise conditions.

- [80] Morrissey, S. J. and Bittner, A. C., Effects of vibration on humans: performance decrements and limits. In Neal, A. S. and Palasik, R. F. (Eds.) Proceedings of the Human Factors Society 21st Annual Meeting, Santa Monica, Calif.: Human Factors Society, 1977.
- [81] O'Hanlon, J. F. and McCauley, M. E., Motion sickness incidence as a function of the frequency of acceleration of vertical sinusoidal motion. Aerospace Medicine, 1974, 45(4), 366-369.
- [82] Parker, D. E., Ritz, L. A., Tubbs, R. L., and Wood, D. L., Effects of Sound on the Vestibular System, Oxford, Ohio: Miami University, 1976. (NTIS No. ADA-025969).
- [83] Rule, B. G., and Nesdale, A. R., Environmental stressors, emotional arousal, and aggression. In Sarason, I. G. and Spielberger, C. D. (Eds.) Stress and Anxiety III, New York: Hemisphere, 1976.

In this chapter the authors discuss both primary stressors, defined here as environmental insult or trauma, and secondary stressors, defined as "immediate or anticipated barriers to ongoing goal activity."

Several possible design factors were identified in this work: 1) unpredictable noise is less easily adapted to than predictable noise; 2) response to a stressor depends upon cognitive factors especially motivation, and attribution of the source of physiological arousal; 3) a few studies suggest that men experience more stress and feel more aggressive and uncomfortable in small rather than large rooms; and 4) when primary and secondary stressors occur in combination, the effect is not additive, but depends on the person's cognitive appraisal of the source of his arousal (i.e., the environment, self, or reaction to another person or persons).

- [84] Slarve, R. N. and Johnson, D. L., Human whole-body exposure to infrasound. Aviation, Space, and Environmental Medicine, 1975, 46(4), 428-431.

- [85] Western, J. B., Infrasound: a short review of effects on man. Aviation, Space, and Environmental Medicine, 1975, 46(9), 1135-1143.
- [86] Whitehead, G. L., et al., Hearing under stress: the effect of hyperventilation and hypercapnia on speech discrimination. Aviation, Space, and Environmental Medicine, 1977, 48(1), 5-6.

This study suggests that a state of hyperventilation causes no significant change in the speech reception threshold but does cause decrement in speech discrimination. The state of hyperventilation can be induced by a reduction of CO₂ tension or, in some cases, by the introduction of stress.

ELECTROMAGNETIC RADIATION

- [87] Bennet, C. A., and Rey, P., What's so hot about red? Human Factors, 1972, 14(2), 149-154.

This experiment suggests that the common sense design practice of using colors at the red end of the spectrum for feelings of "warmth" and colors at the blue end for "coolness" has no basis in fact.

- [88] Birren, F., Color and Human Response. New York: Van Nostrand Reinhold Company, 1978.

This book is a popularized look at the effects of color on man. The biological and psychological effects of color are discussed but not well documented. It may be that color could be a very cost effective component in an overall psychological deterrents system, but well controlled experimentation is needed to confirm or deny that speculation. No such experimentation was documented in this book.

- [89] Chisum, G. T., et al. Flashblindness Following Double Flash Exposures. Warminster, Pa.: Naval Air Development Center, April 5, 1974. (NTIS No. AD-777698).

This study suggests that the luminance of a flash rather than its temporal characteristics is the most significant factor affecting flashblindness. The authors also imply that flashblindness protection devices are available which have occlusion times of 165 s or less.

- [90] Demers, M. T., A Study of Human Visual Recovery from Glare. Texarkana, Tex.: Army Material Command, March 1973. (NTIS No. AD-768123).

In this study, using dark-adapted subjects, recovery from glare took 10 to 40 s with an average of about 30 s.

- [91] Holl, H. B., Fundamentals in Visibility. Redstone Arsenal, Ala.: U.S. Army Missile Research and Development Command, February 1977. (NTIS No. AD/A-040836).

This report covers subject areas such as: visual acuity, determination of minimum visibility, visibility of light sources, brightness and illumination of sky and terrain, changes from day to night, the color of skylight, and variations in visibility during a day.

- [92] Michaelson, S. M., Radio-Frequency and Microwave Energies, Magnetic and Electric Fields. In Marbarger, J. P. and Vasil'yev, P. V. (Eds.) Foundations in Space Biology and Medicine, Volume II, Book 2. Washington, D.C.: NASA, 1975, (No. NASA-SP-374-Vol-2-BK-2).

- [93] Pinkerton, E. and Humphrey, N. K., The apparent heaviness of colours. Nature, July 1974, 250, 164-165.

This experiment suggests that colored stimuli are subjectively "heavier" than a white comparison stimulus. Brightness was controlled. Colors were not compared directly to each other. In comparison to the white standard stimulus, red was the heaviest, followed by blue, green, and orange, with yellow being the lightest. No mention was made of the effects of hue saturation, or color preference.

- [94] Shostak, V. I., Color perception after intensive photostimulation. Kosmicheskaya Biologiya I Aviakosmicheskaya Meditsina. (Space Biology and Aerospace Medicine). 1975, 9(5), 57-60.

Dark adapted subjects who were exposed to a brief, intensive light source (80 ms and 1600 candle/s) suffered color perception disturbances. The pattern and duration of the disturbances depended on the spectral composition and intensity of the light stimulus.

TEMPERATURE

- [95] Allan, J. R., Marcus, P., and Saxton, C., Effect of cold hands on an emergency egress procedure. Aerospace Medicine, 1974, 45(5), 479-481.
- [96] Army Research Institute of Environmental Medicine, U.S. Army Medical Research and Development Technical Report, Washington, D.C.: U.S. Army Medical Research and Development Command, 1974. (NTIS No. AD/A-001543).
- [97] Astrand, J., Axelsson, O., Erikson, U., and Olander, L., Heat Stress in Occupational Work. Ambio, 1975, 4(1), 37-42.
- [98] Axelsson, O., Influence of heat exposure on productivity. Work-Environment-Health. 1974, 11(2), 94-99.
- [99] Blatteis, C. M. and Lutherer, L. O., Effect of altitude exposure on thermoregulatory response of man to cold. Journal of Applied Psychology, 1976, 41(6), 848-858.
- [100] Dressendorfer, R. H., Smith, R. M., Baker, D. G., and Hong, S. K., Cold Tolerance of Long-Distance Runners and Swimmers in Hawaii. Honolulu, Hawaii: University of Hawaii, 1977. (NTIS No. PB-275203).
- [101] Girling, F. and Topliff, E. D. L., The effect of breathing 15%, 21%, and 100% oxygen on the shivering response of nude human subjects at 10 C. Canadian Journal of Physiology and Pharmacology, 1966, 44, 495-499.
- [102] Grether, W. F., Human performance at elevated environmental temperatures. Aerospace Medicine, 1973, 44(7), 747-755.
- [103] Harrison, E. A., Cold Weather Stress on Humans (A Bibliography with Abstracts), Springfield, Va.: National Technical Information Service, 1978. (NTIS No. PS-78/0540).
- [104] Hemingway, A., Shivering. Physiological Review, 1963, 43, 397-422.
- [105] Horvath, S. M., Physiological Responses to Cold. Santa Barbara, Calif.: Institute of Environmental Stress (U. of C.), date unknown, (NTIS No. PB-273254).

- [106] Kissen, A., Reifler, C. B., and Thaler, V. H., Modification of thermoregulatory responses to cold by hypnosis. Journal of Applied Physiology, 1964, 19(6), 1043-1050.
- [107] Lahiri, S., Weitz, C. A., Milledge, J. S., and Fishman, M. C., Effects of hypoxia, heat, and humidity on physical performance. Journal of Applied Physiology, 1976, 40(2), 206-210.
- [108] Lewis, L. T. and Alford, J. J., The influence of season on assault. Professional Geographer, 1975, 27(2), 214-217.

Concerning seasonal effects on crime, Lewis and Alford found no direct relationship between specific temperatures and assault. There does seem to be a seasonal trend, however. "---low assault rates are recorded throughout the country from November to May and high rates are recorded in the remaining months. This trend cannot be explained by increased social contact because it takes place even in subtropical climates. The author suggests that the mechanism may be either relative changes in temperature (increases of 68° to 88° in the South yielding the same results as increases of 38° to 58° in the North) or, secondly, that violence, for some unknown cultural/historical reasons, begins its season in May in all parts of the country.

- [109] Lockhard, J. M., Kiess, H. O., and Clegg, T. J., Effect of rate and level of lowered finger surface temperature on manual performance. Journal of Applied Psychology, 1975, 60(1), 106-113.
- [110] O'Hanlon, J. F., McGrath, J. J., and McCauley, M. E., Body temperature and temporal acuity. Journal of Experimental Psychology, 1974, 102(5), 788-794.
- [111] Poulton, E. C., Hunt, J. C. R., Mumford, J. C., and Poulton, J. The mechanical disturbance produced by steady and gusty winds of moderate strength: skilled performance and semantic assessments. Ergonomics, 1975, 18(6), 651-673.
- [112] Ramey, J. D. and Morrissey, S. J., A composite view of task performance in hot environments. In Neal, A. S. and Palasek, R. F. (Eds) Proceedings of the Human Factors Society 21st Annual Meeting, Santa Monica, Calif.: Human Factors Society, 1977.
- [113] Shvartz, E. and Magazanik, A., Tolerance to heat following cold stress. Aerospace Medicine, 1973, 44(7), 725-729.
- [114] Timbal, J., Colin, J., and Boutelier, C., Circadian variations in the sweating mechanism. Journal of Applied Physiology, 1975, 39(2), 226-230.
- [115] Vanggaard, L., Physiological reactions to wet-cold. Aviation, Space, and Environmental Medicine, 1975, 46(1), 33-36.
- [116] Wilkerson, J. E., Raven, P. B., Boldnan, N. W., and Horvata, S. M., Adaptations in man's adrenal function in response to acute cold stress. Journal of Applied Physiology, 1974, 36(2), 183-189.
- [117] Wilson, O., Goldman, R. F., and Molnar, G. W., Freezing temperature of finger skin. Journal of Applied Physiology, 1976, 41(4), 551-558.

STRENUOUS PHYSICAL EXERTION

- [118] Bates, B. T., Osternig, L. R., and James, S. L., Fatigue effects in running, Journal of Motor Behavior, 1977, 9(3) 203-207.

- [119] Borg, G., Psychological Aspects of Physical Activities, in Larson, L. A. ed., Fitness, Health, and Work Capacity. N.Y.: MacMillan Pub., 1974.
- [120] Cerretelli, P., Exercise and Endurance, in Larson, L. A. ed., Fitness, Health, and Work Capacity, N.Y.: MacMillan Pub., 1974.
- [121] Couzelis, P. M., Circadian variations in responses of trained and untrained men to submaximal exercise. (Doctoral dissertation, Kent State Univ., 1976) Ann Arbor, Mich.: Xerox University Microfilms (No. 77-3821).

The author found circadian rhythms in blood pressure, pulse pressure, tidal volume, blood lactate, and serum potassium during exercise. These rhythms could not be overridden by exercising at a specific time each day. This study suggests that nighttime decrements in performance cannot be overcome by simple changes in the training schedule.

- [122] Evans, Wayne, Performance on a Skilled Task after Physical Work or in a High Altitude Environment, Journal of Perceptual & Motor Skills, 1966, 22, 371-380.
- [123] Gruber, A., Dunlap, J. W., DeNittis, G., Sanders, J. L., Perry, V. and Dixon, B. D., Development of a Methodology for Measuring Infantry Performance in Rifle Firing and Reloading. Ft. Lee, Va.: USATECOM Proj. No. 8-3-7700-01, Phase II, 1965.
- [124] Ilmarinen, J., Rutenfranz, J., Kylian, H., and Flint, F., Untersuchung zur Tagesperiodik verschiedener Kreislauf- und Atemgrößen bei submaximalen und maximalen Leistungen am Fahrradergometer. European Journal of Applied Physiology, 1975, 34(4), 255-267.

The authors suggest that working capacity is less at night, but only if the task is near the limit of the subject's endurance capacity; otherwise the decrement is not significant.

- [125] Morgan, W. P., Raven, P. B., Drinkwater, B. L., and Horvath, S. M., Perceptual and Metabolic Responsivity to Standard Bicycle Ergometry Following Various Hypnotic Suggestions. Washington, D.C.: U.S. Government Printing Office, 1971, (NTIS No. AD767447).
- [126] Szmodis, I., Exercise effects on the time of reactions to auditory stimuli, European Journal of Applied Physiology, 1977, 37, 39-46.
- [127] Young, M. E., Effects of Fatigue on Human Behavior and Performance, A Bibliography Covering the Years, 1964-1979, Springfield, Va.: NTIS/U.S. Dept. of Commerce, 1979. (NTIS No. P5-79/0071).

PAIN

- [128] Carterette, E. C. and Friedman, M. P. (Eds.) Handbook of Perception, Vol. VIB, Feeling and Hurting. New York: Academic Press, 1978.
- [129] Mumford, J. M., Newton, A. V., and Ley, P., Personality, pain perception and pain tolerance. British Journal of Psychology, 1973, 64(1), 105-107.
- [130] Sinka, A. K. P., Experimental induction of anxiety by conditions of uncertainty. (Doctoral dissertation, Univ. of Mich., 1950). Ann Arbor, Mich.: University Microfilms. (No. 00-02465).

In this study the author successfully generated various levels of anxiety (self-report and physiological measures) by varying the level of "uncertainty" with which shocks are presented. Most interesting are: 1) the finding that sessions in which the subject felt he had some control over shocks via successful performance of a pursuit task were more anxiety-provoking than sessions in which shocks were not contingent upon performance; 2) the mere announcement of the conditions of uncertainty produced the same physiological effects as the concrete events themselves. The author concludes that the expectation of pain is not as important in the generation of anxiety as is the uncertainty associated with those expectations.

- [131] Sternbach, R. A., Psychological dimensions and perceptual analyses, including pathologies of pain. In Carterette, E. C. and Friedman, M. P. (Eds). Handbook of Perception, Vol. VIB, Feeling and Hurting. N.Y.: Academic Press, 1978.

Sternbach discusses pain threshold, pain tolerance, pain endurance, anxiety, and cognitive factors affecting pain. He also includes sections of personality parameters and pathologies of pain.

SMELL

- [132] Cain, W. S., The odoriferous environment and the application of olfactory research. In Carterette, E. C. and Friedman, M. P., Handbook of Perception, Vol. VIA, Testing and Smelling, New York: Academic Press, 1978.

Cain gives a good treatment to the subjects of adaptation, mixing, masking and counteraction, and includes an interesting section on chemical communication and pheromones.

- [133] Engen, T., Kuisma, J. E., and Eimas, P. D., Short term memory of odors. Journal of Experimental Psychology, 1973, 99(2), 222-225.

The authors note in the introduction that man can identify 3 levels of odor intensity and 16 different odor qualities. This capability could be used in some kind of multisensory coding.

- [134] Harper, R., Human Senses in Action, London: Churchill Livingstone, 1972.

- [135] Johnston, J. R., Moulton, D. G., and Turk, A., Communication by Chemical Signals, Vol. I, N.Y.: Appleton-Century - Crofts, 1970.

This highly technical book is not directly related to the nuclear theft problem, but it does suggest an area of research which has thus far been ignored, that is, the psychological effects of certain smells or pheromones. Messages which are conveyed by mammals in this way (and there is the possibility that man also communicates this way) are listed, including: territory marking, warning, defense, alarm, submission, encouragement of approach, distress-signalling, and pain indication. Pheromones may be useful in enhancing the psychological deterrence of a system, but the required human research in this area has yet to be done. This book shows what can be done in animal studies and opens the imagination to many possibilities in the realm of human research.

- [136] Rovee, C. K., Harris, S. L., and Topp, R., Olfactory thresholds and level of anxiety. Bulletin of the Psychonomic Society, 1973, 2(2), 76-78.

This study suggests that anxiety causes a decrement in olfactory sensitivity. A second result of interest was that all subjects, anxious or not, found it very hard to discriminate differences of concentration of the stimulus.

PERCEPTUAL PROCESSES

- [137] Biederman, I., Glass, A. L., and Stacy, E. W., Searching for objects in real-world scenes. Journal of Experimental Psychology, 1973, 97(1), 22-27.

The authors found that speed of detection of a target was slowed when the scene was jumbled, especially when the target was not present, but had a high probability of being present in the scene. The mode of "jumbling" was, however, inappropriate for use in the real world (photos were cut and rearranged). Complication of real-world scenes through physical rearrangement may deserve some research.

- [138] Braunstein, M. L., Depth Perception through Motion, New York: Academic Press, 1976.

Chapter 5, "Slant Perception" is the only chapter with possible application to security systems. Both static and dynamic slant perception are discussed. Detailed discussion of the relative contribution of various environmental cues permits the design of a variety of slant illusions.

- [139] Coren, S. and Girgus, J. S., Seeing is Deceiving The Psychology of Visual Illusions. Hillsdale, N.J.: Lawrence Erlbaum Assoc., Publishers, 1978.

This is a very readable account of the history of visual illusions and their application to both theoretical and real-world problems. The authors analyze illusions of size, direction, location, and shape. They evaluate the relative contribution of perceptual cues, developmental and cultural experience, and learned perceptual strategies. A short section on eye movement and illusion destruction implies that illusions which are presented for only a short time are the most effective. Many of the illusions discussed could be attempted in a nuclear security setting at a low cost.

- [140] Dickinson, J., Proprioceptive Control of Human Movement, London: Lepus Books, 1974.

Two chapters of this book, "Proprioception and Performance" and "Proprioception and Learning," may have application to nuclear security especially regarding the coding and tooling of arming mechanisms. The author states that vision is the primary means of monitoring performance. Proprioceptive information is secondary, and in cases of conflicting input, proprioceptive information is transformed to agree with visual feedback. This suggests that "braille" codes in which vision plays no part or gives conflicting information will be more difficult to perform. Another finding of interest was that proprioceptive sensitivity is greater in the dominant arm. This suggests that designing a braille code arming device that can only be manipulated with the left hand would make the arming task more difficult for the majority of the population. Transfer of learning effects could be minimized by violating learned stereotypes such as turning a bolt clockwise to tighten.

- [141] Leibowitz, H. W., Detection of peripheral stimuli. In Visual Search, Washington, D.C.: National Academy of Sciences, 1973.

The author cites reports which confirm the hypothesis that when foveally and peripherally presented stimuli compete for attention, peripheral stimuli

have lower priority. This "tunnel vision" effect has also been caused by environmental stressors and danger-induced stress. However, several experimenters reported that under conditions of heat stress and exertion, subjects showed no decrement in either foveal or peripheral visual fields. Further research is suggested.

- [142] Muhar, I. S., Effect of stress on perception. Indian Journal of Psychology, 1974, 49(4), 291-297.

This study investigated changes in perception when a presented distortion is accompanied by stress. The experimenter found that subjects under stress perceived distortions faster and perceived distortions as being of greater magnitude than unstressed subjects. This suggests that although visual distortions may be recognized as such by an intruder, the effect may still disturb timing, coordination, and judgments of distance.

- [143] Stubbs, D. F., What the eye tells the hand. Journal of Motor Behavior, 1976, 8(1), 43-58.

This author concludes that the speed and accuracy of hand manipulations are negatively affected by the lack of visual cues for posture maintenance. This suggests that the blanking of the visual field in the FEDS system could be augmented by the addition of sloped surfaces or "rock and roll" obstacles.

- [144] Weiss, E. B., Weather control: an instrument for war? Survival, 1975, 17(2), 64-68.

In this article the author speculates about the possible military applications of weather control. Many of these applications could be used to enhance a deterrence system if they are found to be cost-effective. Among the weather modifications discussed were: fog generation, increasing rainfall, increasing snowpack, and generation of hail. These techniques seem more appropriate for specific, tactical response situations than long-term, non-specific deterrence. Several weather control techniques could be used to enhance detection on a long term basis however.

- [145] Williams, L. G., Studies of extrafoveal discrimination and detection. In Visual Search. Washington, D.C.: National Academy of Sciences, 1973.

Although the author is concerned with target detection, much of his discussion could be used in the design of camouflage and illusions. For instance, Williams reports that subjects searching for multidimensional targets prioritize target characteristics according to their situational potency - in this particular experiment the hierarchy was: 1) color, 2) size, and 3) shape. If this kind of information could be empirically determined for objects in a bunker, or bunkers in an arsenal, the objects, bunkers, and weapons could be made less discriminable from other parts of the surrounding environment.

INFORMATION OVERLOAD

- [146] Chatterjee, A., The effect of distraction stress on information processing performance. Behaviorometric, 1973, 3(2), 74-83.

This study confirms the degrading effect of information overload on recall. The overloading was accomplished by simultaneously presenting two tasks, a short-term memory task and a simple problem solving task.

- [147] DeGreene, K. B., Systems Psychology, New York: McGraw-Hill Book Co., 1970.

Among the subject areas covered in this book are several which have some relevance to nuclear security systems and deterrents. Specifically, they are: chapter 12, "Systems Staffing"; chapter 13, "Training: Men-Man and Man-Machine Communication," and chapter 14, "Psychophysiological Stress: Environmental Factors Leading to Degraded Performance." This latter chapter, though oriented toward the point of view of reducing stress to improve performance, can be used to devise ways of increasing stress and anxiety, and degrading performance.

- [148] Graveling, R. A., and Brooke, J. D., An analysis of stress and the characteristics of the human response to stress. In Brooke, J. D. (Ed.) British Proceedings of Sports Psychology, 1974, 203-211.

The authors discuss the effects of environmental load on the human organism. They provide a chart which succinctly details some of the responses one may expect to occur when the human organism is loaded to near capacity. Among these responses are pupillary dilation, hypertension, tachycardia, changes in skin resistance, and changes in muscle tone.

- [149] Lazarus, R. S., Deese, J., and Osler, S. F., Review of Research on Effects of Psychological Stress Upon Performance. Lackland AFB, San Antonio, Tex.: Perception and Motor Skills Laboratory, Human Resources Research Center Air Training Command. 1951 (NTIS No. AD-A010669).

Because of ethical considerations, there are very few stress studies being done at present. Some of the least restricted work was done 20-30 yr ago. This report reviews some of them and lists some of the experimental procedures used to produce stress, such as: mixing unsolvable tasks into a group of solvable ones; interruption of tasks; giving false norms of performance and false feedback; using any strong extraneous sensory input as background "noise"; rapid pacing; and multiple tasks. One of the most interesting responses to stress which were observed was the tendency to stereotyped responses. This finding could be used to optimize the probability of detection of an adversary, given that further research confirms this effect. Other common responses to stress are discussed. Although this document is very old, it is well worth reading and could be useful to an imaginative system designer.

- [150] Pachella, R. G., Intellectual Performance under Stress. Arlington, Va.: Advanced Research Projects Agency, Sept. 1976. (NTIS No. ADA-038196).

This review suggests that although there are some individuals who seem to be generally unaffected by situational stress, there are a few universal effects. One such effect is the inability of both relaxed and anxious people to detect logical inconsistencies when trying to remember meaningful information. The author discusses various methods of controlling information overload, the relationship between motor control and information overload, and the effects of speed stress.

- [151] Simonov, P. V., Psychophysiological stress of space flight. In Marbarger, J. P. and Vasil'yev, P. V., Foundations of Space Biology and Medicine. Washington, D.C.: NASA, 1975.

Assuming that a well-trained adversary and a well-trained astronaut share some motivational and character attributes, this article may have some relevance to nuclear security systems. The author describes the differences observed in astronauts in simulation (no stress) and real flights (stressful). In flight:

- 1) there is an increased awareness of the responsibility to complete difficult actions, and an increased awareness of the responsibility to "do it right the 1st time" because there may be no second chance.

- 2) men become increasingly perceptive to everything in the environment that they perceive to have information relevant to the situation, including noises, vibration, and occasionally this is paralleled by a distorted concept of the situation.

The author cites the facilitating effect of prior conditioning. Those who had positive emotions from overcoming past difficulties in their life were more likely to succeed in overcoming present difficulties.

The author states that even in cases where procedures are performed perfectly, there is an element of emotional stress, and that this stress emanates from the element of risk perceived by the person, the "pragmatic uncertainty" of success. The Yankelevich coefficient for emotional stress is given: number of known failures/number of known attempts. This formula could be optimized by correct information dissemination. The author also suggests that feedback is necessary for some men to correctly perform certain tasks. When deprived of this capability to monitor their performance, they become unsure, confused, and performance degrades.

- [152] Gallagher, R. J., Stimmell, K. G., and Wagner, N. R., The Configuration of Road Convoys: A Simulation Study. Albuquerque, N. Mex., Sandia Laboratories, 1977.

This report is a description of a computerized model of the transport cycle. The model suggests that random placement of the "target vehicle" in a convoy increases the probability of both vehicle and personnel survival. The implication is that any added element of uncertainty is a deterrent because the probability of a successful attack is lessened.

PERSONAL THREAT

- [153] Baker, G. W. and Chapman, D. W., Man and Society in Disaster, New York: Basic Books, 1962.

This book has general relevance to the nuclear theft problem, especially for those who are concerned with possible post-theft scenarios. Of special interest to those interested in deterrence were: chapter 3, "Psychological Effects of Warnings" by Irving L. Janis, chapter 4, "Reaction to Uncertain Threat" by Stephen B. Withey, and chapter 10, "Dimensions of Models in Disaster Behavior" by Dwight W. Chapman.

Janis discusses an adaptive process common among men in hazardous professions which he calls "danger-contingent" reassurances, a combination of selective vigilance and self-reassurance. This may be analogous to the mind set of the criminal or terroristic intruder. To generate the greatest fear, Janis says, give a great deal of unambiguous information about the impending danger and no information about how to cope with it or what resources are available to cope with it. Ambiguous information may tend to increase vigilance when the threat is of "moderate or high" intensity.

In chapter 4, Withey characterizes "threat" as stress with the additional characteristic of probability. He elaborates at least five primitive characteristics of threat: 1) probability; 2) qualitative nature, such as pain, and deprivation; 3) estimated magnitude; 4) timing; and 5) possibility of escape or adaptation. He also presents a 15 point scenario of "reactions to threat" in which reactions are seen as stages of progressive adaptation, each stage, more costly to the organism than the one previous. Chapman discusses behavioral modelling in general and Withey's model of reaction to threat (chapter 4) in particular. His chapter is well thought out and should be read by anyone interested in behavioral modelling of disastrous or dangerous events.

- [154] Baron, R. A., Threatened retaliation from the victim as an inhibitor of physical aggression. Journal of Research in Personality, 1973, 7(2), 103-115.

This study suggests that threatened retaliation from the victim was highly effective in inhibiting subsequent aggression only for subjects who had not previously been angered by the victim, and was relatively ineffective in preventing such behavior in subjects who had previously been exposed to strong provocation. More interesting were the possible mechanisms hypothesized to underly this behavior - 1) the perception that the provoked will "lose face," and 2) that the emotional arousal connected with possible retaliation will be, on one hand, interpreted by the subject as fear and, on the other, as rage.

Baron suggests two other, more effective, ways of dealing with highly provoked aggressors: 1) the introduction of restrained, nonaggressive models, and 2) eliciting empathic arousal in the aggressor by increasing the perceived suffering of the victim. (This latter suggestion seems to contradict this author's findings elsewhere [164].)

- [155] Baron, R. A., Threatened retaliation as an inhibitor of human aggression: mediating effects of the instrumental value of aggression. Bulletin of the Psychonomic Society, 1974, 3(3B), 217-219.

This study is one of the few controlled experiments on the effect of threatened punishment. Results suggest that threatened punishment is a very weak deterrent to human aggression.

- [156] Brown, S. C. and Martin, J. N. T. (Eds.) Human Aspects of Man-Made Systems, St. Albans, Great Britain: The Open University, Press, 1977.

Poulton's chapter gives a concise discussion of skilled performance and stress. The most common kinds of stress are listed as: personal threat, multiple tasks, noise, heat, sleep loss and drugs. Poulton suggests: 1) that a common way of trying to overcome stress is to concentrate on what the subject believes to be the important aspects of the task; 2) combined stresses can be additive or neutralizing in their effects depending on their arousal properties; 3) two decisions cannot be made at once, unless one of them involves an "overlearned" skill. Starr's section on social benefit versus technological risk is interesting to those in the nuclear field, but is only indirectly related to psychological deterrents.

- [157] Chaiken, J. M., What's Known about Deterrent Effects of Police Activities. Santa Monica, Calif.: The Rand Corp., 1976. (DDC/NTIS No. ADA040854).

Chaiken's treatment of the deterrent effects of police activity is succinct and pragmatic. Some of the deterrent effects observed and discussed are displacement of crimes in time and place, time delays in the onset of deterrence, and what the author calls phantom effects, in which police activities deter crimes at times and in places where the police are not in operation, similar to the psychological concept of generalization. Chaiken hypothesizes that phantom effects "occur because potential criminals have imperfect or false information about operational details, perhaps engendered by deliberate deception by the police." Chaiken concludes that only very large increases in the amount of patrol will produce detectable deterrent effects.

- [158] Cooper, C. L. and Payne, R., Stress at Work. New York: John Wiley and Sons, 1978.

This well-written book includes a very concise discussion of environmental stressors in chapter 2. Relevant topics covered in that chapter include: flicker, noise, vibration, temperature effects, perceived danger, and combined stressors.

- [159] Ferguson, W. N., Psychological deterrent value of the patrol dog. Military Police Law Enforcement Journal, 1975, 1(5), 52-53.

This article discusses not only the deterrent effects of patrol dogs, but also discusses the underlying assumptions of deterrence itself. The author points out that the psychological effectiveness of the patrol dog depends on two intervening variables: 1) visibility, that is, in the public relations sense; and 2) the credibility of the handler's release criterion.

- [160] Grosser, G. H., Wechsler, H., and Greenblatt, M. (Eds.) The Threat of Impending Disaster, Cambridge, Mass.: The M.I.T. Press, 1964.

There are several chapters in this book which are of interest to those in the nuclear field. From the deterrence point of view, Lazarus' treatment of stress experimentation is well worth reading. The most interesting concept discussed was that some physiological stress reactions are generated equally as well by anticipation as by reality. (See also, Sinka [130].) Williams, in his chapter on warning-response systems, suggests that an ambiguous warning will be interpreted in the most optimistic way possible; other parts of this chapter and several other chapters would be invaluable for conceptualizing post-theft scenarios.

- [161] Janis, I. L., Air War and Emotional Stress, New York: McGraw-Hill Book Co., 1951.

This book, although old, is not outdated. Several factors were cited as contributing to the elicitation of fear reactions: 1) element of randomness and uncertainty; 2) experiencing a "near-miss" or the loss of a friend or relative; and 3) the sight of mutilated casualties. Janis also discusses the reinforcing effect of "remote-misses," in which fear is replaced by confidence because of the subject's "successful escape." He also discusses the extinguishing of the fear response by non-meaningful alerts. It is suggested that darkness and fog enhance fear reactions by masking salient cues in the environment. Janis also discusses some social psychology concepts that give insight to possible post-theft scenarios.

- [162] Musheno, M. C., Levine, J. P., Palumbo, D. J., Television surveillance and crime prevention: evaluating an attempt to create defensible space in public housing. Social Science Quarterly, 1978, 58(4), 647-656.

This study suggests that certain types of crime are not deterred by the presence of T.V. surveillance. However, these results may not be generalizable to the nuclear theft situation since those doing the surveillance in this study were private citizens, not police officers, MPs, or security guards.

- [163] Study suggests predictable criminal behavior. Trial, 1977, 13(Oct.), 11-13.

This article offers one preliminary finding of interest: "offenders who found themselves frustrated in accomplishing a crime because of tight security said they merely substituted a secondary target..." This statement was derived from a Rand interview sample of 49 imprisoned armed robbers. Should this displacement phenomenon occur within the nuclear security situation, it is possible to imagine scenarios such as off-site assassination of security personnel, kidnapping and extortion plots, and alternative nuclear targets such as reactors, or manufacturing plants.

(This displacement effect is also discussed in Jan M. Chaiken's report, What's Known about Deterrent Effects of Police Activities, 1976 [157].)

CONTINGENCY PLANNING AND CRISIS MANAGEMENT

- [164] Baron, R. A., Aggression as a function of victim's pain cues, level of prior anger arousal, and exposure to an aggressive model. Journal of Personality and Social Psychology, 1974, 29(1), 117-124.

Baron's article supports the hypothesis that signs of pain and suffering reinforce aggressive behavior in highly provoked subjects. If we assume that a potential intruder is such a highly provoked or angered person, pleas for mercy or other signs of suffering will not only be ineffective but may facilitate further aggressive behaviors.

- [165] Geen, R. G., Stonner, D., and Shope, G. L., The facilitation of aggression by aggression: evidence against the catharsis hypothesis. Journal of Personality and Social Psychology, 1975, 31(4), 721-726.

The authors provide further evidence for the hypothesis that aggressive behavior is reinforcing to itself. Aggression seems to increase in frequency as it becomes reinforced as a mode of releasing frustration.

- [166] National Advisory Committee on Criminal Justice Standards and Goals. Disorders and Terrorism: Report of the Task Force on Disorders and Terrorism. Washington, D.C.: U.S. Dept. of Justice, Law Enforcement Assistance Administration, 1976.

The following standards were presented as part of the committee's report and have relevance to the concepts of contingency planning and crisis management: 4.1 and 8.1, Contingency Planning; 4.2, Interagency Cooperation, 4.11, Relief and Restoration Measures; 4.13, Aftermath Measures; 6.2, Planning for Mass Disorders; 6.24, Relations with Mental Health Professions; 6.3 Planning the Police Response to Individual and Small-Group Terrorism and Quasi-Terrorism; 6.6, Bureaucratic Organization of Prevention and Response Efforts; 6.16, Negotiation under Duress; 6.26, Community Relations Efforts in the Aftermath of Extraordinary Violence; 7.1 Judicial Participation in Planning for Response to Extraordinary Violence; 10.6, Professional and Nonprofessional Intervention in Incidents of Extraordinary Violence; 10.11, Community Action in the Aftermath of Disorder and Terrorism; 10.12 Followup Reporting of Extraordinary Violence by News Media; and 10.13, Research Efforts in the Aftermath of Extraordinary Violence.

- [167] Schlossberg, H. and Freeman, L., Psychologist with a Gun. New York: Coward, McCann, and Geoghegan, Inc., 1974.

This book is an anecdotal rather than technical work written by a police officer/psychologist in the New York Police Department. Of interest are certain tactics which the N.Y.P.D. instituted for hostage situations: 1) wait it out if at all possible, giving top priority to the saving of lives; 2) use news blackout if necessary to reduce crowd size; 3) use lighting blackout; 4) keep the situation as non-violent as possible by ordering cease-fire once the field of fire has been cleared and officers are under cover; 5) allow the adversary to perceive some chance of escape - if the situation is perceived hopeless, a desperate act is more likely; and 6) use some non-aggressive method to keep the adversary vigilant and, in doing this, fatigue him quickly - the example given by Schlossberg was driving an armored ambulance back and forth in front of a store where gunmen were holding 11 people hostage. The authors also briefly discuss the social interaction process with the public noting that "The public's attitude toward the police is vital in determining how effective the police are."

U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET	1. PUBLICATION OR REPORT NO. NBS IR 80-2038	2. Gov't. Accession No.	3. Recipient's Accession No.
4. TITLE AND SUBTITLE Psychological Deterrents to Nuclear Theft: An Updated Literature Review and Bibliography		5. Publication Date May 1980	
		6. Performing Organization Code	
7. AUTHOR(S) George W. Lapinsky, Jr. and Clare Goodman		8. Performing Organ. Report No.	
9. PERFORMING ORGANIZATION NAME AND ADDRESS NATIONAL BUREAU OF STANDARDS DEPARTMENT OF COMMERCE WASHINGTON, DC 20234		10. Project/Task/Work Unit No.	
		11. Contract/Grant No.	
12. SPONSORING ORGANIZATION NAME AND COMPLETE ADDRESS (Street, City, State, ZIP) Surety and Operations Directorate Defense Nuclear Agency Washington, D.C. 20305		13. Type of Report & Period Covered	
		14. Sponsoring Agency Code	
15. SUPPLEMENTARY NOTES <input type="checkbox"/> Document describes a computer program; SF-185, FIPS Software Summary, is attached.			
16. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.) A review of the unclassified literature dealing with psychological deterrents was conducted for the Defense Nuclear Agency (DNA). The review indicates that while human psychological processes (sensory, perceptual, and cognitive) can be manipulated by various means, definitive empirical data are lacking which directly relate to deterring nuclear weapon theft. Behavioral impact research should be undertaken by DNA to ascertain the deterrence values of the many techniques identified.			
17. KEY WORDS (six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons) Cognitive processes; nuclear weapon theft; perceptual processes; psychological deterrence; security systems; sensory processes.			
18. AVAILABILITY <input checked="" type="checkbox"/> Unlimited <input type="checkbox"/> For Official Distribution. Do Not Release to NTIS <input type="checkbox"/> Order From Sup. of Doc., U.S. Government Printing Office, Washington, DC 20402, SD Stock No. SN003-003- <input type="checkbox"/> Order From National Technical Information Service (NTIS), Springfield, VA. 22161		19. SECURITY CLASS (THIS REPORT) UNCLASSIFIED	21. NO. OF PRINTED PAGES 45
		20. SECURITY CLASS (THIS PAGE) UNCLASSIFIED	22. Price



